Exelon. Nuclear

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April 28, 2006
BW060049

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Subject: 2005 Radioactive Effluent Release Report

The attached document includes the Radioactive Effluent Release Report for Braidwood Station. This report is being submitted in accordance with 10 CFR 50.36a, "Technical specifications on effluents from nuclear power reactors," and Technical Specification 5.6.3, "Radioactive Effluent Release Report," and includes a summary of radiological liquid and gaseous effluents and solid waste released from the site from January 2005 through December 2005.

If you have any questions regarding this information, please contact Mr. Dale Ambler, Regulatory Assurance Manager, at (815) 417-2800.

Respectfully,

for

Keith J. Polson
Site Vice President
Braidwood Station

Attachment

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Braidwood Station

IE48

RADIOACTIVE EFFLUENT RELEASE REPORT

Supplemental Information

January - December 2005

Facility: BRAIDWOOD NUCLEAR POWER STATION

Licensee: EXELON GENERATION COMPANY, LLC

1. Regulatory Limits

   a. For Noble Gases:

      Dose Rate

      1) Less than 500 mrem/year to the whole body.
      2) Less than 3000 mrem/year to the skin.

      Dose Gamma Radiation

      1) Less than or equal to 5 mrad/quarter.
      2) Less than or equal to 10 mrad/year.

      Beta Radiation

      1) Less than or equal to 10 mrad/quarter.
      2) Less than or equal to 20 mrad/year.

   b. Iodine: (summed with particulate, see below)

   c. Particulates with half-lives > 8 days:

      Dose Rate

      1) Less than 1500 mrem/year.

      Dose

      1) Less than or equal to 7.5 mrem/quarter.
      2) Less than or equal to 15 mrem/year.

   d. For Liquid

      1) Less than or equal to 1.5 mrem to the whole body during any calendar quarter.
      2) Less than or equal to 5 mrem to any organ during any calendar quarter.
      3) Less than or equal to 3 mrem to the whole body during any calendar year.
      4) Less than or equal to 10 mrem to any organ during any calendar year.

2. Maximum Permissible Concentration

   a. Fission and Activation Gasses: 10CFR20 Appendix B Table 2
   b. Iodine: 10CFR20 Appendix B Table 2
   c. Particulates: 10CFR20 Appendix B Table 2
   d. Liquid Effluents: 10 X 10CFR20 Appendix B Table 2

3. Average Energy

   This item is not applicable. Release rates are calculated using an isotopic mix rather than average energy.

4. Measurements and Approximations of Total Radioactivity

   a. <u>Fission and Activation Gases, Iodines, and Particulates</u>

      Containment batch releases are analyzed for noble gas and tritium before being discharged by gamma isotopic and scintillation, respectively. Gaseous decay tanks are analyzed for noble gas before being discharged by gamma isotopic. Released activity is normally calculated using volume of release, which is determined by change in tank or containment pressure.

      The Auxiliary Building ventilation exhaust system is continually monitored for iodines and particulates. These samples are pulled every 7 days and analyzed by gamma isotopic. The particulate samples are also analyzed quarterly for gross alpha and Sr-89/90.

      Noble gas and tritium grab samples are pulled and analyzed weekly by gamma isotopic and scintillation, respectively. The average flow at the release points are used to calculate the curies released.

   b. <u>Liquid Effluents</u>

      The liquid release tanks are analyzed before discharge by gamma isotopic and for tritium. A representative portion of this sample is saved. This is composited, every 31 days, with other discharges that occurred and is analyzed for tritium and gross alpha. The batch composites are composited quarterly and sent to a vendor for Sr-89/90 and Fe-55 analysis. Circulating Water Blowdown, Condensate Polisher Sump and Waste Water Treatment are analyzed weekly by gamma isotopic and for tritium. These weekly samples are composited monthly. The monthly composites are then composited quarterly and sent to a vendor for Sr-89/90 and Fe-55 analysis.

      The tank volumes and activities are used to calculate the curies released for the liquid release tanks. The total volume of water released and the activity is used to calculate the diluted activity released at the discharge point from batch discharges.

4. c. Less than the lower limit of detection (<LLD).

Samples are analyzed such that the Offsite Dose Calculation Manual (ODCM) LLD requirements are met. When a nuclide is not detected during the quarter then <LLD is reported.

d. Summary of Assessment of Offsite Doses from Inadvertent Releases of Water from Blowdown Line at Braidwood Station

Calculations based on gaseous and liquid effluents, Kankakee River flow and meteorological data indicate that public dose due to radioactive material attributable to Braidwood Station during the period does not exceed regulatory or Offsite Dose Calculation Manual (ODCM) limits.

The Total Effective Dose Equivalent (TEDE) due to licensed activities at Braidwood Station calculated for the maximally-exposed individual for the period has been calculated not to exceed 3.51E-01 mrem. The annual limit of TEDE is 100 mrem.

In the spring of 2005, tritium was detected above background level concentration in the site's east side perimeter ditch. This prompted groundwater studies in the summer and fall of 2005 that indicated contamination of the groundwater. Past failures at three vacuum breaker valves in the blowdown line that returns water from the cooling lake to the Kankakee River in 1996, 1998, 2000 and 2003 were known to have released tritium (as well as other radionuclides in much lower concentrations) into the ground. The offsite dose to a member of the public was assessed based upon conservative assumptions. This assessment is provided as Attachment 2.

The assessment of radiation doses to the public due to routine effluent releases is performed in accordance with the ODCM. The results of these analyses for routine releases as well for the groundwater contamination confirm that the Station is operating well within the dose limits of 10CFR50, Appendix I, 10CFR20 and 40CFR190.

The dose receptor for the groundwater contamination pathway assessment represents a different location and exposure pathway than that assumed for the maximally exposed individual in the Offsite Dose Calculation Manual. Thus there is no increase in reported dose to the maximum individual for the years 1996 to 2005. The dose assessment demonstrated that at no time did the dose exceed that of the maximum individual dose reported for the 1996-2005 time period. Therefore the doses already reported for those years continue to represent the highest potential dose to a member of the public.

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
GAS RELEASES
UNIT 1 (Docket Number 50-456)
SUMMATION OF ALL RELEASES

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est. Total Error%
A. Fission and Activation Gas Releases						
1. Total Release Activity	Ci	1.99E+00	8.08E-01	9.60E+00	6.98E-01	7.59
2. Average Release Rate	uCi/sec	2.56E-01	1.03E-01	1.21E+00	8.78E-02	
3. Percent of ODCM Limit - gamma	%	1.38E-04	8.39E-05	3.67E-02	1.14E-04	
4. Percent of ODCM Limit - beta	%	1.18E-03	4.11E-04	7.49E-03	2.72E-04	
B. Iodine Releases						
1. Total I-131 Activity	Ci	1.37E-05	8.36E-05	1.38E-04	1.22E-05	33.20
2. Average Release Rate	uCi/sec	1.76E-06	1.06E-05	1.74E-05	1.53E-06	
3. Percent of ODCM Limit - gamma	%	1.24E-01	5.02E-01	5.47E-01	1.50E-01	
C. Particulate (> 8 day half-life) Releases						
1. Gross Activity	Ci	<LLD	1.01E-05	<LLD	<LLD	19.80
2. Average Release Rate	uCi/sec	0.00E+00	1.28E-06	0.00E+00	0.00E+00	
3. Percent of ODCM Limit	%	N/A	5.02E-01	N/A	N/A	
4. Gross Alpha Activity	Ci	<LLD	<LLD	<LLD	<LLD	
D. Tritium Releases						
1. Total Release Activity	Ci	3.90E+01	1.65E+01	4.53E+01	9.86E+00	8.07
2. Average Release Rate	uCi/sec	5.02E+00	2.10E+00	5.70E+00	1.24E+00	
3. Percent of ODCM Limit	%	1.24E-01	5.02E-01	5.47E-01	1.50E-01	

Note: LLD Values are included in Appendix A of this report.

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
GAS RELEASES
UNIT 1 (Docket Number 50-456)
CONTINUOUS MODE AND BATCH MODE

Nuclides Released		**Continuous Mode**				**Batch Mode**			
	Unit	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
1. Fission Gases									
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	1.26E-03	<LLD	<LLD	<LLD
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	1.22E+00	2.96E-01	3.92E-01	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	1.62E-03
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	5.26E+00	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-131m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	2.62E-02	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	7.69E-01	5.11E-01	3.87E+00	6.94E-01
Xe-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	9.34E-04	2.68E-02	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	2.69E-04	<LLD	2.35E-02	2.40E-03
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	5.26E+00	<LLD	1.99E+00	8.08E-01	4.34E+00	6.98E-01
2. Iodines									
I-131	Ci	1.76E-06	2.84E-05	2.69E-05	7.94E-06	<LLD	<LLD	<LLD	<LLD
I-132	Ci	<LLD	<LLD	9.35E-06	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	1.20E-05	5.52E-05	9.41E-05	4.25E-06	<LLD	<LLD	<LLD	<LLD
I-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	7.42E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.38E-05	8.36E-05	1.38E-04	1.22E-05	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-57	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Br-82	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	1.01E-07	<LLD	<LLD
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
GAS RELEASES
UNIT 1 (Docket Number 50-456)
CONTINUOUS MODE AND BATCH MODE

Nuclides Released		**Continuous Mode**				**Batch Mode**			
	Unit	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	1.01E-07	<LLD	<LLD
4. Tritium	Ci	3.88E+01	1.64E+01	4.50E+01	9.77E+00	2.02E-01	1.12E-01	2.62E-01	8.30E-02

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
GAS RELEASES
UNIT 2 (Docket Number 50-457)
SUMMATION OF ALL RELEASES

A. Fission and Activation Gas Releases

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est. Total Error%
1. Total Activity Released	Ci	1.38E+00	4.24E-01	2.67E+00	1.37E-02	7.59
2. Average Release Rate	uCi/sec	1.77E-01	5.39E-02	3.36E-01	1.72E-03	
3. Percent of ODCM Limit - gamma	%	4.21E-05	2.86E-05	3.77E-04	2.18E-06	
4. Percent of ODCM Limit - beta	%	9.41E-04	2.67E-04	1.18E-03	5.28E-06	

B. Iodine Releases

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est. Total Error%
1. Total I-131 Activity	Ci	<LLD	1.16E-05	<LLD	<LLD	33.20
2. Average Release Rate	uCi/sec	0.00E+00	1.48E-06	0.00E+00	0.00E+00	
3. Percent of ODCM Limit	%	N/A	1.87E-01	N/A	N/A	

C. Particulate (> 8 day half-life) Releases

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est. Total Error%
1. Gross Activity	Ci	<LLD	7.04E-06	<LLD	<LLD	19.80
2. Average Release Rate	uCi/sec	0.00E+00	8.95E-07	0.00E+00	0.00E+00	
3. Percent of OCDM Limit	%	NA	1.87E-01	N/A	N/A	
4. Gross Alpha Activity	Ci	<LLD	<LLD	<LLD	<LLD	

D. Tritium Releases

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est. Total Error%
1. Total Release Activity	Ci	6.22E+01	1.75E+01	4.12E+01	1.67E+02	8.07
2. Average Release Rate	uCi/sec	8.00E+00	2.23E+00	5.18E+00	2.10E+01	
3. Percent of ODCM Limit	%	1.77E-01	1.87E-01	1.17E-01	4.74E-01	

Note: LLD Values are included in Appendix A of this report.

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
GAS RELEASES
UNIT 2 (Docket Number 50-457)
CONTINUOUS MODE AND BATCH MODE

Nuclides Released		Continuous Mode				Batch Mode			
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1. Fission Gases									
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	1.26E-03	<LLD	<LLD	<LLD
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	1.22E+00	2.96E-01	3.92E-01	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-131m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	2.62E-02	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	1.60E-01	1.19E-01	2.20E+00	1.37E-02
Xe-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	9.34E-04	2.68E-02	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	2.01E-03	8.31E-03	2.01E-02	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	1.38E+00	4.24E-01	2.67E+00	1.37E-02
2. Iodines									
I-131	Ci	<LLD	9.18E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-132	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	<LLD	2.37E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	1.16E-05	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-57	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	4.47E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Br-82	Ci	<LLD	2.57E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
GAS RELEASES
UNIT 2 (Docket Number 50-457)
CONTINUOUS MODE AND BATCH MODE

Nuclides Released		**Continuous Mode**				**Batch Mode**			
	Unit	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nd-147	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	7.04E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
4. Tritium	Ci	6.18E+01	1.69E+01	4.11E+01	1.67E+02	4.22E-01	6.89E-01	1.10E-01	1.70E-01

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
LIQUID RELEASES
UNIT 1 (Docket Number 50-456)
SUMMATION OF ALL RELEASES

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est. Total Error %
A. Fission and Activation Products						
1. Total Activity Released	Ci	1.17E-02	8.52E-03	4.43E-03	2.56E-03	2.64
2. Average Concentration Released	uCi/ml	2.17E-09	2.51E-09	1.76E-09	8.45E-10	
3. Percent of limit	%	*	*	*	*	
B. Tritium						
1. Total Activity Released	Ci	2.69E+02	2.10E+02	1.82E+02	2.20E+02	5.85
2. Average Concentration Released	uCi/ml	5.00E-05	6.19E-05	7.25E-05	7.26E-05	
3. % of Limit (1E-2 uCi/ml)	%	5.00E-01	6.19E-01	7.25E-01	7.26E-01	
C. Dissolved Noble Gases						
1. Total Activity Released	Ci	8.29E-04	2.41E-03	7.41E-04	8.11E-04	2.64
2. Average Concentration Released	uCi/ml	1.54E-10	7.10E-10	2.95E-10	2.68E-10	
3. % of Limit (2E-4 uCi/ml)	%	7.70E-05	3.55E-04	1.48E-04	1.34E-04	
D. Gross Alpha						
1. Total Activity Released	Ci	<LLD	<LLD	<LLD	<LLD	14.70
2. Average Concentration Released	uCi/ml	<LLD	<LLD	<LLD	<LLD	
E. Volume of Releases						
1. Volume of Liquid Waste to Discharge	liters	1.55E+06	1.98E+06	1.67E+06	7.41E+05	
2. Volume of Dilution Water	liters	5.38E+09	3.39E+09	2.51E+09	3.03E+09	

Note: LLD Values are included in Appendix A of this report.

*This limit is equal to 10 times the concentration values in Appendix B, Table 2, Column 2 to 10CFR20.1001-20.2402.

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
LIQUID RELEASES
UNIT 1 (Docket Numbers 50-456)
CONTINUOUS MODE & BATCH MODE

Nuclides Released		Continuous Mode				Batch Mode			
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
H-3	Ci	1.00E+01	5.59E+01	5.16E+00	1.27E-01	2.59E+02	1.54E+02	1.77E+02	2.20E+02
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	5.92E-06	<LLD	<LLD	<LLD	7.96E-04	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	6.99E-05	1.21E-04	2.53E-05	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-57	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	1.77E-03	3.45E-03	2.40E-03	2.27E-03
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	7.37E-05	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	7.31E-04	8.72E-04	5.72E-04	2.42E-04
Ni-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	1.87E-04	7.40E-04	8.10E-04
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	3.75E-05	1.39E-04	3.33E-06	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	2.01E-06	4.94E-05	<LLD	<LLD
Nb-97	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-97	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sb-122	Ci	<LLD	<LLD	<LLD	<LLD	4.80E-06	2.71E-05	<LLD	<LLD
Te-123m	Ci	<LLD	<LLD	<LLD	<LLD	2.99E-05	6.84E-04	5.49E-05	3.12E-05
Sb-124	Ci	<LLD	<LLD	<LLD	<LLD	6.75E-06	4.31E-05	1.21E-04	<LLD
Sb-125	Ci	<LLD	<LLD	<LLD	<LLD	2.56E-04	4.97E-04	1.25E-03	1.82E-05
Te-125m	Ci	<LLD	<LLD	<LLD	<LLD	7.81E-03	1.71E-03	<LLD	<LLD
Xe-131m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-132	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	3.30E-06	<LLD	<LLD
Te-132	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	3.68E-06	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	8.29E-04	1.92E-03	<LLD	<LLD

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
LIQUID RELEASES
UNIT 1 (Docket Numbers 50-456)
CONTINUOUS MODE & BATCH MODE

Nuclides Released		Continuous Mode				Batch Mode			
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Xe-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	1.22E-05	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	2.41E-05	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	2.91E-04	<LLD	<LLD
I-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-136	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	3.57E-04	2.71E-05	<LLD	<LLD
Cs-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-139	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Np-239	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	1.00E+01	5.59E+01	5.16E+00	1.27E-01	2.59E+02	1.54E+02	1.77E+02	2.20E+02

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
LIQUID RELEASES
UNIT 2 (Docket Number 50-457)
SUMMATION OF ALL RELEASES

	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est. Total Error %
A. Fission and Activation Products						
1. Total Activity Released	Ci	1.17E-02	8.52E-03	4.43E-03	2.56E-03	2.64
2. Average Concentration Released	uCi/ml	2.17E-09	2.51E-09	1.76E-09	8.45E-10	
3. Percent of Limit	%	*	*	*	*	
B. Tritium						
1. Total Activity Released	Ci	2.69E+02	2.10E+02	1.82E+02	2.20E+02	5.85
2. Average Concentration Released	uCi/ml	5.00E-05	6.19E-05	7.25E-05	7.26E-05	
3. % of Limit (1E-3 uCi/ml)	%	5.00E-01	6.19E-01	7.25E-01	7.26E-01	
C. Dissolved Noble Gases						
1. Total Activity Released	Ci	8.29E-04	2.41E-03	7.41E-04	8.11E-04	2.64
2. Average Concentration Released	uCi/ml	1.54E-10	7.10E-10	2.95E-10	2.68E-10	
3. % of Limit (2E-4 uCi/ml)	%	7.70E-05	3.55E-04	1.48E-04	1.34E-04	
D. Gross Alpha						
1. Total Activity Released	Ci	<LLD	<LLD	<LLD	<LLD	14.70
2. Average Concentration Released	uCi/ml	<LLD	<LLD	<LLD	<LLD	
E. Volume of Releases						
1. Volume of Liquid Waste to Discharge	liters	1.55E+06	1.98E+06	1.67E+06	7.41E+05	
2. Volume of Dilution Water	liters	5.38E+09	3.39E+09	2.51E+09	3.03E+09	

Note: LLD Values are included in Appendix A of this report.

*This limit is equal to 10 times the concentration values in Appendix B, Table 2, Column 2 to 10CFR20.1001-2402.

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
LIQUID RELEASES
UNIT 2 (Docket Numbers 50-457)
CONTINUOUS MODE & BATCH MODE

Nuclides Released		Continuous Mode				Batch Mode			
	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
H-3	Ci	1.00E+01	5.59E+01	5.16E+00	1.27E-01	2.59E+02	1.54E+02	1.77E+02	2.20E+02
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	5.92E-06	<LLD	<LLD	<LLD	7.96E-04	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	6.99E-05	1.21E-04	2.53E-05	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-57	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	1.77E-03	3.45E-03	2.40E-03	2.27E-03
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	7.37E-05	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	7.31E-04	8.72E-04	5.72E-04	2.42E-04
Ni-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	1.87E-04	7.40E-04	8.10E-04
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	3.75E-05	1.39E-04	3.33E-06	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	2.01E-06	4.94E-05	<LLD	<LLD
Nb-97	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-97	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sb-122	Ci	<LLD	<LLD	<LLD	<LLD	4.80E-06	2.71E-05	<LLD	<LLD
Te-123m	Ci	<LLD	<LLD	<LLD	<LLD	2.99E-05	6.84E-04	5.49E-05	3.12E-05
Sb-124	Ci	<LLD	<LLD	<LLD	<LLD	6.75E-06	4.31E-05	1.21E-04	<LLD
Sb-125	Ci	<LLD	<LLD	<LLD	<LLD	2.56E-04	4.97E-04	1.25E-03	1.82E-05
Te-125m	Ci	<LLD	<LLD	<LLD	<LLD	7.81E-03	1.71E-03	<LLD	<LLD
Xe-131m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-132	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	3.30E-06	<LLD	<LLD
Te-132	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	3.68E-06	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	8.29E-04	1.92E-03	<LLD	<LLD

BRAIDWOOD NUCLEAR POWER STATION
ANNUAL EFFLUENT REPORT FOR 2005
LIQUID RELEASES
UNIT 2 (Docket Numbers 50-457)
CONTINUOUS MODE & BATCH MODE

Nuclides Released		**Continuous Mode**				**Batch Mode**			
	Unit	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Xe-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	1.22E-05	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	2.41E-05	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	2.91E-04	<LLD	<LLD
I-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-136	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	3.57E-04	2.71E-05	<LLD	<LLD
Cs-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-139	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Np-239	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for period	Ci	1.00E+01	5.59E+01	5.16E+00	1.27E-01	2.59E+02	1.54E+02	1.77E+02	2.20E+02

BRAIDWOOD NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2004
SOLID RADIOACTIVE WASTE
UNIT 1 AND 2 COMBINED (Docket Numbers 50-456 and 50-457)

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL

1. Types of Waste

Process Waste	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Yr total
Total (m3) =	8.58E+01	9.99E+02	9.28E+00	1.02E+01	2.05E+02
Total (Ci) =	1.54E+01	1.84E+01	1.46E+02	4.58E+02	6.38E+02
% Error =	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01

Dry Active Waste	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Yr total
Total (m3) =	7.64E+01	2.64E+02	0.00E+00	3.82E+01	3.40E+02
Total (Ci) =	2.91E-02	5.57E-01	0.00E+00	1.29E-02	6.15E-01
% Error =	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01

2. Estimate of major nuclide composition (by type of waste)

Process Waste

Nuclide	1st Qtr Ci	2nd Qtr Ci	3rd Qtr Ci	4th Qtr Ci	Yr total Ci	% Composition
Cs-137	5.74E-01	1.22E-01	3.43E+01	1.17E+02	1.52E+02	2.37E+01
*Fe-55	3.68E+00	2.18E+00	2.60E+01	8.24E+01	1.14E+02	1.79E+01
Cs-134	2.50E-01	1.02E-01	2.12E+01	7.25E+01	9.41E+01	1.47E+01
Co-60	2.70E+00	1.04E+00	2.31E+01	6.23E+01	8.91E+01	1.40E+01
Zn-65	2.18E-03	9.85E-03	1.80E+01	6.33E+01	8.13E+01	1.27E+01
*Ni-59	7.26E-02	1.62E-02	1.29E+01	4.52E+01	5.82E+01	9.11E+00
Co-58	4.83E-01	1.26E+01	6.60E+00	2.44E+00	2.21E+01	3.47E+00
Mn-54	1.04E-01	5.42E-01	3.17E+00	9.95E+00	1.38E+01	2.16E+00
*Ni-63	6.90E+00	1.59E+00	4.81E-01	7.24E-01	9.69E+00	1.52E+00
*C-14	1.87E-01	4.14E-02	4.68E-01	1.51E+00	2.20E+00	3.45E-01
H-3	4.35E-01	6.44E-03	3.33E-03	8.70E-01	1.31E+00	2.06E-01

*Activities based on 10CFR61 scaling factors

2. Estimate of major nuclide composition (by type of waste) (continued)

Dry Active Waste

Nuclide	1st Qtr Ci	2nd Qtr Ci	3rd Qtr Ci	4th Qtr Ci	Yr total Ci	% Composition
Co-58	1.58E-02	1.73E-01	0.00E+00	3.62E-03	1.93E-01	3.13E+01
H-3	0.00E+00	1.40E-01	0.00E+00	6.39E-03	1.47E-01	2.38E+01
*Fe-55	1.15E-02	9.44E-02	0.00E+00	9.09E-04	1.07E-01	1.74E+01
*Ni-63	8.64E-03	6.90E-02	0.00E+00	4.43E-04	7.81E-02	1.27E+01
Co-60	5.60E-03	4.53E-02	0.00E+00	3.37E-04	5.12E-02	8.32E+00
Nb-95	8.37E-04	1.18E-02	0.00E+00	8.79E-06	1.27E-02	2.06E+00
Mn-54	1.06E-03	9.15E-03	0.00E+00	1.01E-04	1.03E-02	1.68E+00
Zr-95	5.87E-04	6.66E-03	0.00E+00	0.00E+00	7.25E-03	1.18E+00
Cs-134	3.44E-04	2.84E-03	0.00E+00	3.31E-04	3.51E-03	5.71E-01
Cs-137	2.62E-04	2.10E-03	0.00E+00	7.26E-04	3.08E-03	5.01E-01
Zn-65	1.17E-04	1.03E-03	0.00E+00	0.00E+00	1.15E-03	1.87E-01
*Ni-59	8.81E-05	7.04E-04	0.00E+00	5.29E-06	7.97E-04	1.30E-01

*Activities based on 10CFR61 scaling factors

Number of Shipments: 16

Mode of Transportation: Exclusive Use

Destination: Alaron, Wampum, PA (6)
Barnwell Waste Management Facility, Barnwell, South Carolina (5)
Envirocare, Clive, Utah (4)
GTS Duratek, Kingston, Tennessee (2)
GTS Duratek, Oak Ridge, Tennessee (1)

B. IRRADIATED FUEL SHIPMENTS

No irradiated fuel shipments for January through December, 2005

BRAIDWOOD NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2005
SOLID RADIOACTIVE WASTE
UNIT 1 AND 2 COMBINED (Docket Numbers 50-456 and 50-457)

Shipment Number	Waste Class	Type of Container	Solidification Agent
RWS05-001	AU	General Design	None
RWS05-002	AU	General Design	None
RWS05-003	C	Cast STC	None
RWS05-004	AU	Cask STC	None
RWS05-005	AU	General Design	None
RWS05-006	AU	General Design	None
RWS05-007	AU	Cast STC	None
RWS05-008	AU	General Design	None
RWS05-009	AU	General Design	None
RWS05-010	AU	General Design	None
RWS05-011	AU	Cask STC	None
RWS05-012	AU	General Design	None
RWS05-013	AU	Cask STC	None
RWS05-014	B	Cask Type B	None
RWS05-015	AU	General Design	None
RWS05-016	B	Cask Type B	None
RWS05-017	B	Cask Type A	None
RWS 05-018	C	Cask Type B	None

1. There were no changes to the Braidwood Station Process Control Program in 2005.

2. There were no changes to the installed liquid, gaseous, or solid radwaste treatment systems in 2005. There were no changes to the vendor supplied, non-plant equipment used to process liquid radwaste.

3. There were no liquid release tanks or gas decay tanks which exceeded the limits addressed in the ODCM-RETS.

4. There were no unplanned released of gaseous or liquid effluents in 2005.

5. There were no liquid or gaseous effluent monitoring instruments that exceeded their specified inoperability time in 2005.

6. There were no changes to the Offsite Dose Calculation Manual (ODCM) during 2005.

7. NUREG-0543, Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190) states in section IV, "As long as a nuclear plant site operates at a level below the Appendix I reporting requirements, no extra analysis is required to demonstrate compliance with the 40 CFR Part 190." The organ and whole body doses reported on pages 28 through 47 are determined using 10 CFR 50 Appendix I methodology. The doses are below the limits of Appendix I.

APPENDIX A

LLD Tables

LLD VALUES FOR GASEOUS RELEASES

Isotope	LLD (Ci/ml)
Alpha	7.11E-19
H-3	7.60E-14
Ar-41	7.63E-13
Mn-54	1.89E-18
Co-57	1.02E-18
Co-58	5.67E-19
Fe-59	3.64E-18
Co-60	8.94E-19
Zn-65	4.80E-18
Br-82	7.44E-19
Kr-85	5.83E-11
Kr-85m	7.03E-13
Kr-87	7.59E-13
Kr-88	3.18E-12
Sr-89	1.41E-20
Sr-90	2.71E-21
Mo-99	9.37E-19
I-131	8.96E-19
I-132	2.38E-17
I-133	1.17E-18
Xe-131m	1.82E-11
Xe-133	1.27E-12
Xe-133m	4.87E-12
Cs-134	2.25E-18
I-135	2.88E-18
Xe-135	5.17E-13
Xe-135m	1.48E-11
Cs-137	2.18E-18
Xe-138	4.65E-11
Ba-139	1.04E-15
Ba-140	4.45E-18
La-140	3.64E-18
Ce-141	1.78E-18
Ce-144	7.93E-18

NOTE: LLD Value for total activity released is based on LLD values for individual isotopes used in the calculation.

LLD VALUES FOR LIQUID RELEASES

Isotope	LLD (Ci/ml)
Alpha	4.90E-14
H-3	8.80E-12
Ar-41	3.73E-14
Cr-51	4.46E-13
Mn-54	1.56E-14
Fe-55	6.99E-13
Co-57	4.64E-14
Co-58	4.39E-14
Fe-59	3.94E-14
Co-60	9.40E-14
Zn-65	4.04E-14
Sr-89	4.00E-14
Sr-90	9.23E-15
Nb-95	1.64E-14
Zr-95	1.22E-13
Nb-97	1.51E-13
Mo-99	2.94E-13
Tc-99m	3.00E-13
Ag-110m	7.89E-14
Sb-124	5.43E-14
Sb-125	1.87E-13
Te-125m	1.62E-11
I-131	1.36E-13
Xe-133	1.41E-13
Cs-134	5.02E-14
Cs-137	6.50E-14
Ba-139	3.57E-13
Ba-140	1.50E-13
La-140	5.89E-13
Ce-141	9.35E-14
Ce-144	3.48E-13
Kr-85	9.29E-12
Nb-95	1.64E-14
Sb-122	4.32E-13
Te-123m	4.92E-14
Te-132	2.28E-13
I-132	5.93E-14
I-133	2.37E-11
Cs-136	9.72E-14
Xe-133m	3.81E-13
Xe-131m	1.72E-12
Np-239	1.64E-12
Ba-133	6.31E-14
Xe-135	2.43E-13

NOTE: LLD Value for Total Activity Released is based on LLD Values for individual isotopes used in the calculation.

APPENDIX B

Supplemental Information

BRAIDWOOD NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2005
UNIT COMMON

GASEOUS EFFLUENTS
SUPPLEMENTAL RELEASE INFORMATION

A. Batch Release	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
1. Total Number of Batch Releases	8	2	8	0	**18**
2. Total Time Period for Batch Releases (minutes)	3,984	216	829	0	**5,029**
3. Maximum Time Period for a Batch Release (minutes)	1,810	124	303	N/A	**N/A**
4. Average Time Period for a Batch Release (minutes)	498	108	104	N/A	**N/A**
5. Minimum Time Period for a Batch Release (minutes)	69	92	2	N/A	**N/A**

B. Abnormal Releases					
1. Number of Releases	0	0	0	0	**0**
2. Total Activity Released	0.00	0.00	0.000	0.00	**0.00**

BRAIDWOOD NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2005
UNIT 1 (Docket Number 50-456)

GASEOUS EFFLUENTS
SUPPLEMENTAL RELEASE INFORMATION

A. Batch Release	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
1. Total Number of Batch Releases	28	28	35	33	**124**
2. Total Time Period for Batch Releases (minutes)	1,286	1,113	4,439	2,941	**9,779**
3. Maximum Time Period for a Batch Release (minutes)	130	51	1,340	800	**N/A**
4. Average Time Period for a Batch Release (minutes)	46	40	127	89	**N/A**
5. Minimum Time Period for a Batch Release (minutes)	21	7	16	21	**N/A**

B. Abnormal Releases					
1. Number of Releases	0	0	0	0	**0**
2. Total Activity Released	0.00	0.00	0.000	0.00	**0.00**

BRAIDWOOD NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2005
UNIT 2 (Docket Number 50-457)

GASEOUS EFFLUENTS
SUPPLEMENTAL RELEASE INFORMATION

A. Batch Release	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	**Total**
1. Total Number of Batch Releases	36	31	27	31	**125**
2. Total Time Period for Batch Releases (minutes)	2,337	14,793	1,084	1,848	**20,062**
3. Maximum Time Period for a Batch Release (minutes)	254	6,690	99	535	**N/A**
4. Average Time Period for a Batch Release (minutes)	65	477	40	60	**N/A**
5. Minimum Time Period for a Batch Release (minutes)	23	15	15	9	**N/A**

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B. Abnormal Releases					
1. Number of Releases	0	0	0	0	**0**
2. Total Activity Released	0.00	0.00	0.00	0.00	**0.00**

BRAIDWOOD NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2005
UNIT 1 AND 2 COMBINED (Docket Numbers 50-456 and 50-457)
BRAIDWOOD NUCLEAR POWER STATION

LIQUID EFFLUENTS
SUPPLEMENTAL RELEASE INFORMATION

		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A.	Batch Release					
1.	Total Number of Batch Releases	35	45	37	17	**134**
2.	Total Time Period for Batch Releases (minutes)	6,178	7,541	3,259	3,571	**20,549**
3.	Maximum Time Period for a Batch Release (minutes)	393	399	218	431	**N/A**
4.	Average Time Period for a Batch Release	177	168	88	210	**N/A**
5.	Minimum Time Period for a Batch Release (minutes)	65	32	51	80	**N/A**
6.	Average Stream Flow During Periods of Release of Effluent into a Flowing Stream (liters/min)	1.88E+07	4.95E+06	1.61E+06	2.93E+06	**N/A**
B.	Abnormal Releases					
1.	Number of Releases	0	0	0	0	**0**
2.	Total Activity Released (Ci)	0.00	0.00	0.00	0.00	**0.00**

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 1

=== RELEASE DATA ===

Total Release Duration (minutes)	3.368E+05
Total Release Volume (cf)	5.080E+10
Average Release Flowrate (cfm)	1.508E+05
Average Period Flowrate (cfm)	9.665E+04

=== NUCLIDE DATA ===

Nuclide	uCi	Average uCi/cc	ECrcent Ratio	EC
AR-41	1.26E+03	8.75E-13	8.75E-05	1.00E-08
KR-85M	1.62E+03	1.12E-12	1.12E-05	1.00E-07
KR-85	1.91E+06	1.33E-09	1.90E-03	7.00E-07
XE-133M	2.77E+04	1.93E-11	3.21E-05	6.00E-07
KR-88	5.26E+06	3.66E-09	4.06E-01	9.00E-09
XE-131M	2.62E+04	1.82E-11	9.09E-06	2.00E-06
XE-135	2.62E+04	1.82E-11	2.60E-04	7.00E-08
XE-133	5.84E+06	4.06E-09	8.12E-03	5.00E-07
F&AG	1.31E+07	9.10E-09	4.17E-01	
I-131	6.50E+01	4.52E-14	2.26E-04	2.00E-10
I-132	9.35E+00	6.50E-15	3.25E-07	2.00E-08
I-133	1.66E+02	1.15E-13	1.15E-04	1.00E-09
I-135	7.42E+00	5.16E-15	8.59E-07	6.00E-09
Iodine	2.47E+02	1.72E-13	3.42E-04	
BR-82	1.01E-01	7.02E-17	1.40E-08	5.00E-09
Other	1.01E-01	7.02E-17	1.40E-08	
H-3	1.11E+08	7.69E-08	7.69E-01	1.00E-07
H-3	1.11E+08	7.69E-08	7.69E-01	
Total	1.24E+08	8.60E-08	1.19E+00	

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 1

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 1
Receptor.............: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ===

Age/Path	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
AGPD	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	0.00E+00	8.10E-07
AINHL	1.14E-07	2.93E-03	2.97E-03	2.93E-03	2.93E-03	2.93E-03	0.00E+00	2.93E-03
AVEG	2.91E-06	5.25E-03	6.58E-03	5.26E-03	5.25E-03	5.25E-03	0.00E+00	5.25E-03
AGMILK	1.24E-05	3.63E-03	9.36E-03	3.65E-03	3.62E-03	3.62E-03	0.00E+00	3.63E-03
ACMEAT	3.63E-07	7.55E-04	9.25E-04	7.55E-04	7.55E-04	7.55E-04	0.00E+00	7.55E-04
ACMILK	1.04E-05	1.79E-03	6.56E-03	1.80E-03	1.77E-03	1.78E-03	0.00E+00	1.78E-03
TGPD	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	0.00E+00	8.10E-07
TINHL	1.60E-07	2.95E-03	3.00E-03	2.95E-03	2.95E-03	2.95E-03	0.00E+00	2.95E-03
TVEG	2.77E-06	6.01E-03	7.11E-03	6.01E-03	6.01E-03	6.01E-03	0.00E+00	6.01E-03
TGMILK	2.26E-05	4.74E-03	1.38E-02	4.76E-03	4.70E-03	4.71E-03	0.00E+00	4.72E-03
TCMEAT	3.02E-07	4.50E-04	5.73E-04	4.50E-04	4.50E-04	4.50E-04	0.00E+00	4.50E-04
TCMILK	1.88E-05	2.33E-03	9.88E-03	2.35E-03	2.31E-03	2.31E-03	0.00E+00	2.32E-03
CGPD	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	0.00E+00	8.10E-07
CINHL	2.18E-07	2.61E-03	2.67E-03	2.61E-03	2.61E-03	2.61E-03	0.00E+00	2.61E-03
CVEG	5.14E-06	9.33E-03	1.10E-02	9.33E-03	9.33E-03	9.33E-03	0.00E+00	9.33E-03
CGMILK	5.47E-05	7.51E-03	2.55E-02	7.54E-03	7.45E-03	7.46E-03	0.00E+00	7.48E-03
CCMEAT	5.60E-07	5.45E-04	7.31E-04	5.46E-04	5.45E-04	5.45E-04	0.00E+00	5.45E-04
CCMILK	4.56E-05	3.70E-03	1.87E-02	3.73E-03	3.65E-03	3.66E-03	0.00E+00	3.68E-03
IGPD	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	0.00E+00	8.10E-07
IINHL	1.73E-07	1.50E-03	1.56E-03	1.50E-03	1.50E-03	1.50E-03	0.00E+00	1.50E-03
IGMILK	1.14E-04	1.14E-02	5.51E-02	1.15E-02	1.13E-02	1.13E-02	0.00E+00	1.14E-02
ICMILK	9.52E-05	5.66E-03	4.20E-02	5.67E-03	5.54E-03	5.55E-03	0.00E+00	5.59E-03

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ===

Agegroup	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
ADULT	2.70E-05	1.44E-02	2.64E-02	1.44E-02	1.43E-02	1.43E-02	0.00E+00	1.43E-02
TEEN	4.54E-05	1.65E-02	3.44E-02	1.65E-02	1.64E-02	1.64E-02	0.00E+00	1.65E-02
CHILD	1.07E-04	2.37E-02	5.86E-02	2.38E-02	2.36E-02	2.36E-02	0.00E+00	2.36E-02
INFANT	2.11E-04	1.86E-02	9.87E-02	1.86E-02	1.84E-02	1.84E-02	0.00E+00	1.85E-02

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 1
Receptor.............: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0

=== MAXIMUM PERIOD DOSE TO LIMIT (Any Organ) ====================================

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	INFANT	THYROID	9.87E-02	31-day	2.25E-01	4.39E+01	3.00E-01	3.29E+01
Qrtr->End	INFANT	THYROID	9.87E-02	Quarter	5.63E+00	1.75E+00	7.50E+00	1.32E+00
Year->End	INFANT	THYROID	9.87E-02	Annual	1.13E+01	8.77E-01	1.50E+01	6.58E-01

Critical Pathway........: 3 Grs/Goat/Milk (GMILK)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	1.85E+01
I-131	7.95E+01
I-132	6.52E-05
I-133	1.87E+00
I-135	3.76E-04

=== MAXIMUM PERIOD DOSE TO LIMIT (Tot Body)) ===================================

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	CHILD	TBODY	2.36E-02	31-day	1.50E-01	1.58E+01	2.00E-01	1.18E+01
Qrtr->End	CHILD	TBODY	2.36E-02	Quarter	5.25E+00	4.50E-01	7.50E+00	3.15E-01
Year->End	CHILD	TBODY	2.36E-02	Annual	1.05E+01	2.25E-01	1.50E+01	1.58E-01

Critical Pathway........: 2 Vegetation (VEG)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	9.98E+01
I-131	2.50E-01
I-132	2.84E-05
I-133	8.16E-03
I-135	4.86E-05

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 1
Receptor.............: 4 Composite Crit. Receptor - NG
Distance (meters)....: 0.0
Compass Point........: 0.0

=== MAXIMUM PERIOD NG DOSE TO LIMIT (Gamma) ===

Dose Period	Dose Type	Dose (mrad)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	Gamma	1.85E-03	31-day	1.50E-01	1.24E+00	2.00E-01	9.27E-01
Qrtr->End	Gamma	1.85E-03	Quarter	3.75E+00	4.94E-02	5.00E+00	3.71E-02
Year->End	Gamma	1.85E-03	Annual	7.50E+00	2.47E-02	1.00E+01	1.85E-02

Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
AR-41	1.43E-02
KR-85M	2.42E-03
KR-85	4.00E-02
XE-133M	1.10E-02
KR-88	9.74E+01
XE-131M	4.97E-03
XE-135	6.13E-02
XE-133	2.51E+00

=== MAXIMUM PERIOD NG DOSE TO LIMIT (Beta)) ===

Dose Period	Dose Type	Dose (mrad)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	Beta	9.35E-04	31-day	3.00E-01	3.12E-01	4.00E-01	2.34E-01
Qrtr->End	Beta	9.35E-04	Quarter	7.50E+00	1.25E-02	1.00E+01	9.35E-03
Year->End	Beta	9.35E-04	Annual	1.50E+01	6.23E-03	2.00E+01	4.68E-03

Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
AR-41	1.63E-02
KR-85M	1.25E-02
KR-85	1.47E+01
XE-133M	1.62E-01
KR-88	6.06E+01
XE-131M	1.14E-01
XE-135	2.54E-01
XE-133	2.41E+01

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 2

=== RELEASE DATA ==

Total Release Duration (minutes)................................ 2.293E+05
Total Release Volume (cf)....................................... 2.947E+10
Average Release Flowrate (cfm).................................. 1.285E+05

Average Period Flowrate (cfm)................................... 5.607E+04

=== NUCLIDE DATA ==

Nuclide	uCi	Average uCi/cc	ECrcent Ratio	EC
AR-41	1.26E+03	1.51E-12	1.51E-04	1.00E-08
KR-85	1.91E+06	2.29E-09	3.27E-03	7.00E-07
XE-133M	2.77E+04	3.32E-11	5.54E-05	6.00E-07
XE-131M	2.62E+04	3.13E-11	1.57E-05	2.00E-06
XE-135	3.04E+04	3.64E-11	5.20E-04	7.00E-08
XE-133	2.50E+06	2.99E-09	5.98E-03	5.00E-07
F&AG	4.49E+06	5.38E-09	9.99E-03	
I-131	9.18E+00	1.10E-14	5.50E-05	2.00E-10
I-133	2.37E+00	2.84E-15	2.84E-06	1.00E-09
Iodine	1.16E+01	1.38E-14	5.79E-05	
BR-82	2.57E+00	3.08E-15	6.15E-07	5.00E-09
Other	2.57E+00	3.08E-15	6.15E-07	
H-3	2.88E+08	3.45E-07	3.45E+00	1.00E-07
H-3	2.88E+08	3.45E-07	3.45E+00	
CO-58	4.47E+00	5.36E-15	5.36E-06	1.00E-09
P>=8	4.47E+00	5.36E-15	5.36E-06	
Total	2.92E+08	3.50E-07	3.46E+00	

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 2

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 2
Receptor.............: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ============================

Age/Path	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
AGPD	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	0.00E+00	9.70E-07
AINHL	9.27E-09	7.61E-03	7.61E-03	7.61E-03	7.61E-03	7.61E-03	0.00E+00	7.61E-03
AVEG	3.89E-07	1.37E-02	1.38E-02	1.37E-02	1.37E-02	1.37E-02	0.00E+00	1.37E-02
AGMILK	1.70E-06	9.40E-03	1.02E-02	9.41E-03	9.40E-03	9.40E-03	0.00E+00	9.40E-03
ACMEAT	5.13E-08	1.96E-03	1.99E-03	1.96E-03	1.96E-03	1.96E-03	0.00E+00	1.96E-03
ACMILK	1.42E-06	4.61E-03	5.27E-03	4.61E-03	4.61E-03	4.61E-03	0.00E+00	4.61E-03
TGPD	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	0.00E+00	9.70E-07
TINHL	1.30E-08	7.68E-03	7.68E-03	7.68E-03	7.68E-03	7.68E-03	0.00E+00	7.68E-03
TVEG	3.70E-07	1.56E-02	1.58E-02	1.56E-02	1.56E-02	1.56E-02	0.00E+00	1.56E-02
TGMILK	3.09E-06	1.22E-02	1.35E-02	1.22E-02	1.22E-02	1.22E-02	0.00E+00	1.22E-02
TCMEAT	4.27E-08	1.17E-03	1.19E-03	1.17E-03	1.17E-03	1.17E-03	0.00E+00	1.17E-03
TCMILK	2.58E-06	6.00E-03	7.05E-03	6.00E-03	6.00E-03	6.00E-03	0.00E+00	6.00E-03
CGPD	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	0.00E+00	9.70E-07
CINHL	1.77E-08	6.78E-03	6.78E-03	6.78E-03	6.78E-03	6.78E-03	0.00E+00	6.78E-03
CVEG	6.88E-07	2.43E-02	2.45E-02	2.43E-02	2.43E-02	2.43E-02	0.00E+00	2.43E-02
CGMILK	7.50E-06	1.94E-02	2.19E-02	1.94E-02	1.94E-02	1.94E-02	0.00E+00	1.94E-02
CCMEAT	7.91E-08	1.42E-03	1.44E-03	1.42E-03	1.42E-03	1.42E-03	0.00E+00	1.42E-03
CCMILK	6.25E-06	9.51E-03	1.16E-02	9.51E-03	9.50E-03	9.50E-03	0.00E+00	9.51E-03
IGPD	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	9.70E-07	0.00E+00	9.70E-07
IINHL	1.40E-08	3.90E-03	3.90E-03	3.90E-03	3.90E-03	3.90E-03	0.00E+00	3.90E-03
IGMILK	1.57E-05	2.94E-02	3.55E-02	2.94E-02	2.94E-02	2.94E-02	0.00E+00	2.94E-02
ICMILK	1.31E-05	1.44E-02	1.95E-02	1.44E-02	1.44E-02	1.44E-02	0.00E+00	1.44E-02

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ====================================

Agegroup	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
ADULT	4.55E-06	3.72E-02	3.89E-02	3.72E-02	3.72E-02	3.72E-02	0.00E+00	3.72E-02
TEEN	7.07E-06	4.27E-02	4.52E-02	4.27E-02	4.27E-02	4.27E-02	0.00E+00	4.27E-02
CHILD	1.55E-05	6.13E-02	6.62E-02	6.14E-02	6.13E-02	6.13E-02	0.00E+00	6.13E-02
INFANT	2.97E-05	4.78E-02	5.88E-02	4.78E-02	4.77E-02	4.77E-02	0.00E+00	4.77E-02

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 2
Receptor.............: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0

=== MAXIMUM PERIOD DOSE TO LIMIT (Any Organ) ===================================

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	CHILD	THYROID	6.62E-02	31-day	2.25E-01	2.94E+01	3.00E-01	2.21E+01
Qrtr->End	CHILD	THYROID	6.62E-02	Quarter	5.63E+00	1.18E+00	7.50E+00	8.82E-01
Year->End	CHILD	THYROID	6.62E-02	Annual	1.13E+01	5.88E-01	1.50E+01	4.41E-01

Critical Pathway........: 2 Vegetation (VEG)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	9.27E+01
CO-58	1.34E-03
I-131	7.29E+00
I-133	1.83E-02

=== MAXIMUM PERIOD DOSE TO LIMIT (Tot Body)) ===================================

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	CHILD	TBODY	6.13E-02	31-day	1.50E-01	4.09E+01	2.00E-01	3.07E+01
Qrtr->End	CHILD	TBODY	6.13E-02	Quarter	5.25E+00	1.17E+00	7.50E+00	8.18E-01
Year->End	CHILD	TBODY	6.13E-02	Annual	1.05E+01	5.84E-01	1.50E+01	4.09E-01

Critical Pathway........: 2 Vegetation (VEG)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	9.99E+01
CO-58	2.54E-03
I-131	1.36E-02
I-133	4.50E-05

GASEOUS RELEASE AND DOSE SUMMARY REPORT - BY UNIT
(Composite Critical Receptor - Limited Analysis)

Release ID...........: 1 All Gas Release Types
Period Start Date....: 01/01/2005 00:00
Period End Date......: 01/01/2006 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Unit.................: 2
Receptor.............: 4 Composite Crit. Receptor - NG
Distance (meters)....: 0.0
Compass Point........: 0.0

=== MAXIMUM PERIOD NG DOSE TO LIMIT (Gamma) ===================================

Dose Period	Dose Type	Dose (mrad)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	Gamma	2.25E-05	31-day	1.50E-01	1.50E-02	2.00E-01	1.12E-02
Qrtr->End	Gamma	2.25E-05	Quarter	3.75E+00	6.00E-04	5.00E+00	4.50E-04
Year->End	Gamma	2.25E-05	Annual	7.50E+00	3.00E-04	1.00E+01	2.25E-04

Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
AR-41	1.17E+00
KR-85	3.29E+00
XE-133M	9.10E-01
XE-131M	4.09E-01
XE-135	5.85E+00
XE-133	8.84E+01

=== MAXIMUM PERIOD NG DOSE TO LIMIT (Beta)) ===================================

Dose Period	Dose Type	Dose (mrad)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	Beta	2.39E-04	31-day	3.00E-01	7.96E-02	4.00E-01	5.97E-02
Qrtr->End	Beta	2.39E-04	Quarter	7.50E+00	3.19E-03	1.00E+01	2.39E-03
Year->End	Beta	2.39E-04	Annual	1.50E+01	1.59E-03	2.00E+01	1.19E-03

Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
AR-41	6.36E-02
KR-85	5.73E+01
XE-133M	6.32E-01
XE-131M	4.47E-01
XE-135	1.15E+00
XE-133	4.04E+01

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05
Unit..................: 1

=== MULTIPLE RELEASE POINT MESSAGE ===
Undiluted and Diluted Flowrate(s) and Concentration(s) cannot be combined.

=== RELEASE DATA ===
Total Release Duration (minutes).................................. 1.457E+06
Total Undiluted Volume Released (gallons)......................... NA
Average Undiluted Flowrate (gpm).................................. NA

Total Dilution Volume (gallons)................................... NA
Average Dilution Flowrate (gpm)................................... NA

=== NUCLIDE DATA ===

Nuclide	uCi
NB-97	2.30E+00
SB-122	3.19E+01
SB-124	1.70E+02
SB-125	2.02E+03
BA-133	3.68E+00
TE-123M	7.99E+02
CR-51	8.03E+02
MN-54	2.15E+02
FE-59	7.39E+01
CO-58	9.89E+03
CO-60	2.42E+03
ZR-95	5.14E+01
NB-95	1.79E+02
TE-125M	9.52E+03
I-132	3.30E+00
CS-134	6.08E+02
CS-137	3.83E+02
Gamma	2.72E+04
KR-85	1.74E+03
XE-133M	1.22E+01
XE-135	2.90E+02
XE-133	2.75E+03
D&EG	4.79E+03
H-3	8.81E+08

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05

=== NUCLIDE DATA ===

Nuclide	uCi
Beta	8.81E+08
Total	8.81E+08

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05
Unit..................: 1
Receptor..............: 0 Liquid Receptor

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ===

Age/Path	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
APWtr	1.53E-05	1.95E-02	1.94E-02	1.95E-02	1.94E-02	1.95E-02	0.00E+00	1.95E-02
AFWFSp	1.10E-02	2.81E-02	8.29E-03	1.76E-02	1.02E-02	2.34E-02	0.00E+00	2.34E-02
TPWtr	1.48E-05	1.37E-02	1.37E-02	1.37E-02	1.37E-02	1.37E-02	0.00E+00	1.37E-02
TFWFSp	1.15E-02	2.67E-02	6.42E-03	1.27E-02	8.71E-03	1.73E-02	0.00E+00	1.50E-02
CPWtr	4.28E-05	2.63E-02	2.63E-02	2.63E-02	2.63E-02	2.63E-02	0.00E+00	2.63E-02
CFWFSp	1.42E-02	2.28E-02	5.43E-03	1.06E-02	7.10E-03	9.21E-03	0.00E+00	8.68E-03
IPWtr	4.79E-05	2.59E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	0.00E+00	2.58E-02

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ===

Agegroup	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
ADULT	1.10E-02	4.75E-02	2.77E-02	3.71E-02	2.97E-02	4.29E-02	0.00E+00	4.28E-02
TEEN	1.15E-02	4.04E-02	2.01E-02	2.64E-02	2.24E-02	3.10E-02	0.00E+00	2.87E-02
CHILD	1.42E-02	4.92E-02	3.17E-02	3.69E-02	3.34E-02	3.55E-02	0.00E+00	3.50E-02
INFANT	4.79E-05	2.59E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	0.00E+00	2.58E-02

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05
Unit..................: 1
Receptor..............: 0 Liquid Receptor

=== MAXIMUM PERIOD DOSE TO LIMIT (Any Organ) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	CHILD	LIVER	4.92E-02	31-day	1.50E-01	3.28E+01	2.00E-01	2.46E+01
Qrtr->End	CHILD	LIVER	4.92E-02	Quarter	3.75E+00	1.31E+00	5.00E+00	9.83E-01
Year->End	CHILD	LIVER	4.92E-02	Annual	7.50E+00	6.56E-01	1.00E+01	4.92E-01

Critical Pathway........: 0 Potable Water (PWtr)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	6.39E+01
CR-51	0.00E+00
MN-54	4.66E-02
FE-59	1.03E-02
CO-58	4.84E-02
CO-60	3.48E-02
ZR-95	5.19E-07
NB-95	2.36E-03
TE-125M	5.94E-01
I-132	4.74E-06
CS-134	2.34E+01
CS-137	1.20E+01

=== MAXIMUM PERIOD DOSE TO LIMIT (Tot Body)) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	ADULT	TBODY	4.28E-02	31-day	4.50E-02	9.51E+01	6.00E-02	7.13E+01
Qrtr->End	ADULT	TBODY	4.28E-02	Quarter	1.13E+00	3.81E+00	1.50E+00	2.85E+00
Year->End	ADULT	TBODY	4.28E-02	Annual	2.25E+00	1.90E+00	3.00E+00	1.43E+00

Critical Pathway........: 1 Fresh Water Fish - Sport (FFSP)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	6.42E+01
CR-51	2.36E-02
MN-54	1.32E-02
FE-59	5.14E-03
CO-58	1.50E-01
CO-60	1.04E-01

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05

Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
ZR-95	3.25E-07
NB-95	1.75E-03
TE-125M	2.41E-01
I-132	1.88E-06
CS-134	2.57E+01
CS-137	9.55E+00

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

```
Release ID............: 1  All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05
Unit..................: 2

=== MULTIPLE RELEASE POINT MESSAGE ==========================================
Undiluted and Diluted Flowrate(s) and Concentration(s) cannot be combined.

=== RELEASE DATA ============================================================
Total Release Duration (minutes).................................... 1.457E+06
Total Undiluted Volume Released (gallons)........................... NA
Average Undiluted Flowrate (gpm).................................... NA

Total Dilution Volume (gallons)..................................... NA
Average Dilution Flowrate (gpm)..................................... NA

=== NUCLIDE DATA ============================================================
Nuclide    uCi
---------  --------
NB-97      2.30E+00
SB-122     3.19E+01
SB-124     1.70E+02
SB-125     2.02E+03
BA-133     3.68E+00
TE-123M    7.99E+02
CR-51      8.03E+02
MN-54      2.15E+02
FE-59      7.39E+01
CO-58      9.89E+03
CO-60      2.42E+03
ZR-95      5.14E+01
NB-95      1.79E+02
TE-125M    9.52E+03
I-132      3.30E+00
CS-134     6.08E+02
CS-137     3.83E+02
---------  --------
Gamma      2.72E+04

KR-85      1.74E+03
XE-133M    1.22E+01
XE-135     2.90E+02
XE-133     2.75E+03
---------  --------
D&EG       4.79E+03

H-3        8.81E+08
```

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05

=== NUCLIDE DATA ===

Nuclide	uCi
Beta	8.81E+08
Total	8.81E+08

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05
Unit..................: 2
Receptor..............: 0 Liquid Receptor

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ===

Age/Path	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
APWtr	1.53E-05	1.95E-02	1.94E-02	1.95E-02	1.94E-02	1.95E-02	0.00E+00	1.95E-02
AFWFSp	1.10E-02	2.81E-02	8.29E-03	1.76E-02	1.02E-02	2.34E-02	0.00E+00	2.34E-02
TPWtr	1.48E-05	1.37E-02	1.37E-02	1.37E-02	1.37E-02	1.37E-02	0.00E+00	1.37E-02
TFWFSp	1.15E-02	2.67E-02	6.42E-03	1.27E-02	8.71E-03	1.73E-02	0.00E+00	1.50E-02
CPWtr	4.28E-05	2.63E-02	2.63E-02	2.63E-02	2.63E-02	2.63E-02	0.00E+00	2.63E-02
CFWFSp	1.42E-02	2.28E-02	5.43E-03	1.06E-02	7.10E-03	9.21E-03	0.00E+00	8.68E-03
IPWtr	4.79E-05	2.59E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	0.00E+00	2.58E-02

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ===

Agegroup	Bone	Liver	Thyroid	Kidney	Lung	GI-Lli	Skin	TB
ADULT	1.10E-02	4.75E-02	2.77E-02	3.71E-02	2.97E-02	4.29E-02	0.00E+00	4.28E-02
TEEN	1.15E-02	4.04E-02	2.01E-02	2.64E-02	2.24E-02	3.10E-02	0.00E+00	2.87E-02
CHILD	1.42E-02	4.92E-02	3.17E-02	3.69E-02	3.34E-02	3.55E-02	0.00E+00	3.50E-02
INFANT	4.79E-05	2.59E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	0.00E+00	2.58E-02

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05
Unit..................: 2
Receptor..............: 0 Liquid Receptor

=== MAXIMUM PERIOD DOSE TO LIMIT (Any Organ) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	CHILD	LIVER	4.92E-02	31-day	1.50E-01	3.28E+01	2.00E-01	2.46E+01
Qrtr->End	CHILD	LIVER	4.92E-02	Quarter	3.75E+00	1.31E+00	5.00E+00	9.83E-01
Year->End	CHILD	LIVER	4.92E-02	Annual	7.50E+00	6.56E-01	1.00E+01	4.92E-01

Critical Pathway........: 0 Potable Water (PWtr)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	6.39E+01
CR-51	0.00E+00
MN-54	4.66E-02
FE-59	1.03E-02
CO-58	4.84E-02
CO-60	3.48E-02
ZR-95	5.19E-07
NB-95	2.36E-03
TE-125M	5.94E-01
I-132	4.74E-06
CS-134	2.34E+01
CS-137	1.20E+01

=== MAXIMUM PERIOD DOSE TO LIMIT (Tot Body)) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Strt->End	ADULT	TBODY	4.28E-02	31-day	4.50E-02	9.51E+01	6.00E-02	7.13E+01
Qrtr->End	ADULT	TBODY	4.28E-02	Quarter	1.13E+00	3.81E+00	1.50E+00	2.85E+00
Year->End	ADULT	TBODY	4.28E-02	Annual	2.25E+00	1.90E+00	3.00E+00	1.43E+00

Critical Pathway........: 1 Fresh Water Fish - Sport (FFSP)
Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
H-3	6.42E+01
CR-51	2.36E-02
MN-54	1.32E-02
FE-59	5.14E-03
CO-58	1.50E-01
CO-60	1.04E-01

LIQUID RELEASE AND DOSE SUMMARY REPORT
------ (PERIOD BASIS - BY UNIT) ------

Release ID............: 1 All Liquid Release Types
Period Start Date.....: 01/01/2005 00:00
Period End Date.......: 01/01/2006 00:00
Period Duration (mins): 5.256E+05

Major Contributors......: 0.0 % or greater to total

Nuclide	Percentage
ZR-95	3.25E-07
NB-95	1.75E-03
TE-125M	2.41E-01
I-132	1.88E-06
CS-134	2.57E+01
CS-137	9.55E+00

ATTACHMENT 1

Tables 7-11
Wind Direction and Stability Classes

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	4	0	0	0	4
NNE	0	0	1	0	0	0	1
NE	0	3	9	0	0	0	12
ENE	0	6	1	0	0	0	7
E	0	9	0	0	0	0	9
ESE	0	1	2	0	0	0	3
SE	0	0	4	0	0	0	4
SSE	0	2	1	4	0	0	7
S	0	2	3	6	2	0	13
SSW	1	8	4	2	0	0	15
SW	0	4	3	0	0	0	7
WSW	1	4	5	4	0	0	14
W	0	5	5	4	0	0	14
WNW	0	6	14	4	0	0	24
NW	0	8	20	7	0	0	35
NNW	0	0	20	2	0	0	22
Variable	0	0	0	0	0	0	0
Total	2	58	96	33	2	0	191

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	2	2	0	0	5
NNE	0	0	1	0	0	0	1
NE	0	5	1	0	0	0	6
ENE	0	4	0	0	0	0	4
E	0	3	1	0	0	0	4
ESE	0	3	1	0	0	0	4
SE	0	1	1	0	0	0	2
SSE	0	0	1	0	0	0	1
S	0	2	1	1	0	0	4
SSW	1	1	1	1	0	0	4
SW	0	3	4	0	0	0	7
WSW	0	4	1	1	0	0	6
W	0	8	2	3	0	0	13
WNW	1	3	3	0	0	0	7
NW	0	3	10	0	0	0	13
NNW	0	5	7	0	0	0	12
Variable	0	0	0	0	0	0	0
Total	2	46	37	8	0	0	93

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	1	0	0	1
NNE	0	2	0	0	0	0	2
NE	0	2	1	0	0	0	3
ENE	1	3	1	0	0	0	5
E	0	5	0	0	0	0	5
ESE	0	1	1	0	0	0	2
SE	0	1	1	0	0	0	2
SSE	0	2	1	1	0	0	4
S	0	1	1	1	0	0	3
SSW	0	2	0	0	0	0	2
SW	0	0	1	0	0	0	1
WSW	0	3	4	1	0	0	8
W	0	3	5	3	0	0	11
WNW	0	2	3	1	0	0	6
NW	0	12	5	0	0	0	17
NNW	1	4	6	0	0	0	11
Variable	0	0	0	0	0	0	0
Total	2	43	30	8	0	0	83

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	5	14	16	10	0	0	45
NNE	7	39	35	0	0	0	81
NE	4	45	70	13	0	0	132
ENE	6	48	19	0	0	0	73
E	12	23	1	0	0	0	36
ESE	4	26	23	0	0	0	53
SE	2	5	20	0	0	0	27
SSE	0	12	14	2	0	0	28
S	0	8	32	14	3	0	57
SSW	0	2	23	11	3	0	39
SW	1	13	29	17	0	0	60
WSW	2	9	14	6	1	0	32
W	4	19	18	15	1	0	57
WNW	7	23	32	10	0	0	72
NW	2	60	36	4	0	0	102
NNW	4	43	43	12	0	0	102
Variable	0	0	0	0	0	0	0
Total	60	389	425	114	8	0	996

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	11	17	5	0	0	0	33
NNE	9	12	0	0	0	0	21
NE	7	20	0	1	0	0	28
ENE	27	29	1	0	0	0	57
E	23	8	0	0	0	0	31
ESE	6	30	6	0	0	0	42
SE	3	8	15	1	0	0	27
SSE	4	17	14	1	0	0	36
S	2	10	18	8	0	0	38
SSW	1	6	13	6	2	0	28
SW	1	14	20	8	0	0	43
WSW	2	14	16	0	0	0	32
W	6	7	7	1	0	0	21
WNW	13	29	7	2	0	0	51
NW	20	23	1	0	0	0	44
NNW	12	19	9	2	0	0	42
Variable	0	0	0	0	0	0	0
Total	147	263	132	30	2	0	574

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	0	0	0	0	0	3
NNE	7	0	0	0	0	0	7
NE	7	0	0	0	0	0	7
ENE	12	0	0	0	0	0	12
E	12	0	0	0	0	0	12
ESE	5	1	0	0	0	0	6
SE	0	4	0	0	0	0	4
SSE	1	9	0	0	0	0	10
S	0	4	0	0	0	0	4
SSW	1	0	2	0	0	0	3
SW	2	0	1	0	0	0	3
WSW	0	10	0	0	0	0	10
W	13	9	0	0	0	0	22
WNW	7	1	0	0	0	0	8
NW	5	1	0	0	0	0	6
NNW	3	2	0	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	78	41	3	0	0	0	122

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	0	0	0	0	0	0	0
NNE	2	0	0	0	0	0	2
NE	2	0	0	0	0	0	2
ENE	1	0	0	0	0	0	1
E	5	0	0	0	0	0	5
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	1	0	0	0	0	0	1
W	6	4	0	0	0	0	10
WNW	4	0	0	0	0	0	4
NW	3	0	0	0	0	0	3
NNW	2	0	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	26	4	0	0	0	0	30

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	4	0	0	0	4
NNE	0	0	2	0	0	0	2
NE	0	0	1	0	0	0	1
ENE	0	1	12	3	0	0	16
E	0	0	10	0	0	0	10
ESE	0	0	1	3	0	0	4
SE	0	0	2	3	0	0	5
SSE	0	0	2	1	4	0	7
S	0	1	1	3	4	4	13
SSW	1	5	7	0	2	0	15
SW	0	2	2	3	0	0	7
WSW	0	1	3	4	2	2	12
W	0	1	4	5	3	0	13
WNW	0	5	7	5	2	4	23
NW	0	1	11	11	9	1	33
NNW	0	0	7	17	0	0	24
Variable	0	0	0	0	0	0	0
Total	1	17	76	58	26	11	189

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 2
Hours of missing stability measurements in all stability classes: 25

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	4	0	0	4
NNE	0	0	0	0	0	0	0
NE	0	2	3	2	0	0	7
ENE	0	1	1	0	0	0	2
E	0	1	3	2	0	0	6
ESE	0	1	2	1	0	0	4
SE	0	1	0	1	0	0	2
SSE	0	1	0	1	0	0	2
S	0	0	1	1	1	0	3
SSW	0	2	1	0	1	0	4
SW	1	2	3	2	0	0	8
WSW	0	2	2	2	0	0	6
W	0	2	4	1	2	0	9
WNW	1	1	4	1	1	1	9
NW	0	1	9	4	1	0	15
NNW	0	1	6	3	0	0	10
Variable	0	0	0	0	0	0	0
Total	2	18	39	25	6	1	91

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 2
Hours of missing stability measurements in all stability classes: 25

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	1	0	0	1
NNE	0	1	1	0	0	0	2
NE	1	1	3	0	0	0	5
ENE	0	1	0	0	0	0	1
E	0	3	3	1	0	0	7
ESE	0	1	1	1	0	0	3
SE	0	1	0	1	0	0	2
SSE	0	1	1	1	0	0	3
S	0	1	0	1	1	1	4
SSW	0	2	0	0	0	0	2
SW	0	0	1	1	0	0	2
WSW	0	1	3	1	1	0	6
W	0	2	1	1	0	1	5
WNW	0	2	3	3	4	0	12
NW	0	4	7	2	2	0	15
NNW	0	1	8	4	0	0	13
Variable	0	0	0	0	0	0	0
Total	1	22	32	18	8	2	83

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 1
Hours of missing stability measurements in all stability classes: 25

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	10	15	11	11	0	48
NNE	3	7	36	19	0	0	65
NE	1	3	51	52	10	0	117
ENE	6	16	32	30	7	0	91
E	1	12	30	5	0	0	48
ESE	1	10	12	22	11	0	56
SE	0	3	6	13	8	0	30
SSE	1	0	10	10	3	0	24
S	0	2	18	20	12	7	59
SSW	0	0	5	25	14	6	50
SW	1	3	17	13	12	3	49
WSW	1	6	10	8	7	1	33
W	0	12	13	11	9	3	48
WNW	0	6	15	16	17	5	59
NW	1	7	50	41	12	1	112
NNW	1	10	59	27	8	1	106
Variable	0	0	0	0	0	0	0
Total	18	107	379	323	141	27	995

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 7
Hours of missing stability measurements in all stability classes: 25

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	8	30	1	0	0	39
NNE	0	6	13	2	0	0	21
NE	0	8	19	0	1	0	28
ENE	2	9	25	1	0	0	37
E	1	13	24	1	0	0	39
ESE	1	5	14	22	3	0	45
SE	0	6	6	8	4	0	24
SSE	0	7	9	22	7	0	45
S	1	2	5	21	8	7	44
SSW	1	1	3	11	11	7	34
SW	2	2	11	14	7	2	38
WSW	0	1	8	19	2	0	30
W	1	2	6	8	3	0	20
WNW	1	2	6	10	5	0	24
NW	0	4	48	6	1	0	59
NNW	1	7	24	10	3	0	45
Variable	0	0	0	0	0	0	0
Total	11	83	251	156	55	16	572

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 13
Hours of missing stability measurements in all stability classes: 25

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	3	1	0	0	5
NNE	0	3	5	0	0	0	8
NE	0	3	1	0	0	0	4
ENE	1	6	1	0	0	0	8
E	4	10	4	0	0	0	18
ESE	0	1	4	0	0	0	5
SE	1	4	2	1	0	0	8
SSE	0	6	2	1	0	0	9
S	2	2	5	5	0	0	14
SSW	2	1	1	2	0	0	6
SW	0	2	0	1	2	0	5
WSW	0	2	2	2	0	0	6
W	1	0	6	3	0	0	10
WNW	0	0	10	2	0	0	12
NW	0	0	8	1	0	0	9
NNW	0	2	7	0	0	0	9
Variable	0	0	0	0	0	0	0
Total	11	43	61	19	2	0	136

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 2
Hours of missing stability measurements in all stability classes: 25

Braidwood Nuclear Station

Period of Record: January - March 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	1	2	1	0	0	0	4
NE	0	1	0	0	0	0	1
ENE	2	0	0	0	0	0	2
E	1	0	0	0	0	0	1
ESE	1	2	0	0	0	0	3
SE	0	3	2	0	0	0	5
SSE	1	3	0	0	0	0	4
S	0	2	0	0	0	0	2
SSW	0	1	0	0	0	0	1
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	1	0	0	0	1
WNW	0	3	5	0	0	0	8
NW	0	2	3	0	0	0	5
NNW	1	1	1	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	7	20	13	0	0	0	40

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 2
Hours of missing stability measurements in all stability classes: 25

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	6	2	0	0	9
NNE	0	8	13	9	0	0	30
NE	0	24	12	2	0	0	38
ENE	1	19	2	0	0	0	22
E	0	21	6	0	0	0	27
ESE	0	8	8	0	0	0	16
SE	1	12	8	0	0	0	21
SSE	0	15	15	1	0	0	31
S	1	30	27	1	0	0	59
SSW	1	16	19	12	1	0	49
SW	1	12	9	7	0	0	29
WSW	2	5	18	9	0	0	34
W	0	12	32	13	0	0	57
WNW	2	9	39	3	0	0	53
NW	0	10	12	5	0	0	27
NNW	0	9	2	9	0	0	20
Variable	0	0	0	0	0	0	0
Total	9	211	228	73	1	0	522

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	1	0	0	0	1
NNE	0	3	1	4	0	0	8
NE	2	2	4	1	0	0	9
ENE	2	9	0	0	0	0	11
E	0	3	2	0	0	0	5
ESE	0	0	0	0	0	0	0
SE	0	5	2	0	0	0	7
SSE	0	5	3	0	0	0	8
S	0	5	2	2	0	0	9
SSW	0	3	4	1	0	0	8
SW	0	4	5	3	0	0	12
WSW	2	1	3	1	0	0	7
W	1	5	4	6	0	0	16
WNW	0	2	5	1	0	0	8
NW	0	1	3	1	0	0	5
NNW	0	0	0	4	0	0	4
Variable	0	0	0	0	0	0	0
Total	7	48	39	24	0	0	118

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	0	0	0	2
NNE	0	8	1	4	0	0	13
NE	1	4	4	0	0	0	9
ENE	1	3	0	0	0	0	4
E	0	3	2	0	0	0	5
ESE	0	4	2	0	0	0	6
SE	0	5	4	0	0	0	9
SSE	1	2	1	0	0	0	4
S	1	1	3	3	0	0	8
SSW	0	2	3	0	0	0	5
SW	0	1	0	1	0	0	2
WSW	0	0	2	1	0	0	3
W	1	3	5	2	0	0	11
WNW	1	2	12	3	0	0	18
NW	0	1	1	0	0	0	2
NNW	0	0	1	5	0	0	6
Variable	0	0	0	0	0	0	0
Total	6	39	43	19	0	0	107

Wind Speed (in mph)

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	2	10	14	0	0	28
NNE	0	16	24	13	0	0	53
NE	4	22	40	1	0	0	67
ENE	14	27	6	0	0	0	47
E	13	17	8	0	0	0	38
ESE	2	9	12	1	0	0	24
SE	3	15	6	0	0	0	24
SSE	3	15	8	0	0	0	26
S	0	8	20	3	0	0	31
SSW	0	3	14	6	1	0	24
SW	1	8	17	7	1	0	34
WSW	1	16	15	2	0	0	34
W	4	7	19	5	0	0	35
WNW	1	13	15	2	0	0	31
NW	2	9	10	0	0	0	21
NNW	0	1	8	5	0	0	14
Variable	0	0	0	0	0	0	0
Total	50	188	232	59	2	0	531

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	4	1	0	0	0	9
NNE	5	28	5	0	0	0	38
NE	5	31	1	0	0	0	37
ENE	10	21	0	0	0	0	31
E	20	5	2	0	0	0	27
ESE	10	24	12	0	0	0	46
SE	6	41	4	0	0	0	51
SSE	3	38	18	0	0	0	59
S	3	32	47	2	0	0	84
SSW	0	18	31	0	0	0	49
SW	0	14	13	0	0	0	27
WSW	6	29	8	0	0	0	43
W	9	22	11	1	0	0	43
WNW	6	14	3	0	0	0	23
NW	2	3	3	0	0	0	8
NNW	1	2	3	0	0	0	6
Variable	0	0	0	0	0	0	0
Total	90	326	162	3	0	0	581

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	9	1	0	0	0	0	10
NNE	4	5	0	0	0	0	9
NE	4	0	0	0	0	0	4
ENE	6	1	0	0	0	0	7
E	19	3	0	0	0	0	22
ESE	14	10	0	0	0	0	24
SE	5	11	1	0	0	0	17
SSE	6	4	0	0	0	0	10
S	4	1	0	0	0	0	5
SSW	5	5	0	0	0	0	10
SW	1	8	0	0	0	0	9
WSW	6	14	0	0	0	0	20
W	16	10	0	0	0	0	26
WNW	10	1	0	0	0	0	11
NW	3	1	0	0	0	0	4
NNW	2	0	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	114	75	1	0	0	0	190

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	0	0	0	0	0	1
NNE	0	2	0	0	0	0	2
NE	2	0	0	0	0	0	2
ENE	2	0	0	0	0	0	2
E	11	1	0	0	0	0	12
ESE	5	2	0	0	0	0	7
SE	3	1	0	0	0	0	4
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	1	0	0	0	0	0	1
SW	3	0	0	0	0	0	3
WSW	7	1	0	0	0	0	8
W	6	0	0	0	0	0	6
WNW	2	0	0	0	0	0	2
NW	2	0	0	0	0	0	2
NNW	1	0	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	46	7	0	0	0	0	53

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	5	4	1	0	12
NNE	0	2	6	10	7	0	25
NE	0	10	15	5	2	0	32
ENE	0	14	13	5	0	0	32
E	0	9	12	2	3	0	26
ESE	1	1	6	8	1	0	17
SE	1	8	9	5	0	0	23
SSE	0	8	10	10	1	0	29
S	0	17	33	16	0	0	66
SSW	1	10	8	13	10	3	45
SW	0	7	8	6	3	0	24
WSW	0	5	3	21	6	0	35
W	0	9	6	28	5	1	49
WNW	0	5	11	24	6	4	50
NW	0	2	15	13	11	0	41
NNW	0	3	7	1	6	0	17
Variable	0	0	0	0	0	0	0
Total	3	112	167	171	62	8	523

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 2
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	1	0	0	1
NNE	0	2	1	0	0	0	3
NE	0	1	3	3	4	1	12
ENE	1	6	3	0	0	0	10
E	0	4	0	3	0	0	7
ESE	1	0	1	0	0	0	2
SE	0	3	2	1	0	0	6
SSE	0	1	5	4	0	0	10
S	0	1	4	1	0	2	8
SSW	0	3	5	3	0	1	12
SW	1	0	3	2	3	0	9
WSW	1	0	1	3	1	0	6
W	1	2	2	3	5	1	14
WNW	0	1	2	2	3	0	8
NW	0	1	1	3	1	1	7
NNW	0	0	0	0	4	0	4
Variable	0	0	0	0	0	0	0
Total	5	25	33	29	21	6	119

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	0	1	0	3
NNE	0	1	4	1	2	0	8
NE	1	1	6	2	3	0	13
ENE	2	1	2	0	0	0	5
E	0	1	2	1	1	0	5
ESE	0	1	2	2	1	0	6
SE	0	4	3	2	0	0	9
SSE	0	1	2	1	0	0	4
S	1	0	3	2	2	1	9
SSW	0	0	1	3	0	0	4
SW	0	0	1	0	1	0	2
WSW	0	0	0	2	0	1	3
W	1	2	0	3	1	0	7
WNW	0	0	3	8	10	1	22
NW	1	0	1	1	0	0	3
NNW	0	0	0	1	4	0	5
Variable	0	0	0	0	0	0	0
Total	6	12	32	29	26	3	108

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	2	2	10	14	0	29
NNE	0	1	10	13	9	0	33
NE	2	6	22	34	15	0	79
ENE	1	13	16	10	0	0	40
E	2	24	14	10	6	1	57
ESE	1	3	7	6	9	3	29
SE	0	5	9	7	2	0	23
SSE	1	3	9	7	0	0	20
S	0	2	6	17	4	1	30
SSW	1	0	4	14	7	5	31
SW	0	2	16	10	6	1	35
WSW	1	2	12	11	2	0	28
W	1	1	4	10	8	0	24
WNW	1	2	8	24	8	1	44
NW	0	0	6	10	3	0	19
NNW	1	1	0	6	5	0	13
Variable	0	0	0	0	0	0	0
Total	13	67	145	199	98	12	534

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	1	3	0	0	0	6
NNE	1	3	15	10	0	0	29
NE	0	3	22	9	0	0	34
ENE	1	7	30	9	0	0	47
E	2	6	22	1	2	0	33
ESE	0	3	14	13	7	4	41
SE	0	3	15	27	1	0	46
SSE	0	3	27	18	7	0	55
S	0	1	26	44	14	0	85
SSW	1	1	8	46	11	0	67
SW	1	3	8	15	2	0	29
WSW	1	3	19	14	0	0	37
W	0	6	9	25	1	0	41
WNW	0	0	9	17	1	0	27
NW	0	1	6	5	1	0	13
NNW	0	2	1	4	0	0	7
Variable	0	0	0	0	0	0	0
Total	9	46	234	257	47	4	597

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 1
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	6	0	0	0	8
NNE	0	1	4	2	0	0	7
NE	1	2	7	4	0	0	14
ENE	0	8	4	0	0	0	12
E	0	3	10	1	0	0	14
ESE	0	1	7	14	0	0	22
SE	0	1	7	15	0	0	23
SSE	0	4	9	3	0	0	16
S	0	2	5	0	0	0	7
SSW	0	4	3	0	0	0	7
SW	0	2	6	5	0	0	13
WSW	1	4	4	5	0	0	14
W	0	1	2	13	0	0	16
WNW	0	5	15	6	0	0	26
NW	2	2	10	0	0	0	14
NNW	0	3	3	0	0	0	6
Variable	0	0	0	0	0	0	0
Total	4	45	102	68	0	0	219

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 3
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: April - June 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	1	0	0	0	3
NNE	0	1	2	0	0	0	3
NE	0	3	4	1	0	0	8
ENE	0	1	2	0	0	0	3
E	0	1	3	0	0	0	4
ESE	0	1	1	7	0	0	9
SE	0	0	4	2	0	0	6
SSE	2	3	3	1	0	0	9
S	1	0	0	0	0	0	1
SSW	2	2	2	0	0	0	6
SW	0	1	0	0	0	0	1
WSW	1	3	2	0	0	0	6
W	0	3	2	1	0	0	6
WNW	0	3	3	0	0	0	6
NW	1	1	1	0	0	0	3
NNW	0	2	2	0	0	0	4
Variable	0	0	0	0	0	0	0
Total	7	27	32	12	0	0	78

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	6	0	0	0	0	6
NNE	0	9	4	0	0	0	13
NE	1	10	5	0	0	0	16
ENE	1	3	0	0	0	0	4
E	2	5	0	0	0	0	7
ESE	3	1	0	0	0	0	4
SE	1	4	0	0	0	0	5
SSE	1	2	0	0	0	0	3
S	0	6	1	0	0	0	7
SSW	0	1	2	1	0	0	4
SW	1	3	7	1	0	0	12
WSW	1	1	3	0	0	0	5
W	0	6	0	0	0	0	6
WNW	1	0	1	0	0	0	2
NW	1	7	1	0	0	0	9
NNW	0	3	2	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	13	67	26	2	0	0	108

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	13	4	0	0	0	18
NNE	1	6	11	0	0	0	18
NE	3	13	6	0	0	0	22
ENE	1	15	0	0	0	0	16
E	2	14	0	0	0	0	16
ESE	1	10	2	0	0	0	13
SE	3	16	1	0	0	0	20
SSE	0	34	1	0	0	0	35
S	1	41	9	0	0	0	51
SSW	1	13	34	2	0	0	50
SW	1	13	25	2	0	0	41
WSW	0	15	10	0	0	0	25
W	2	37	16	1	0	0	56
WNW	2	31	12	0	0	0	45
NW	3	33	8	0	0	0	44
NNW	0	22	12	0	0	0	34
Variable	0	0	0	0	0	0	0
Total	22	326	151	5	0	0	504

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	6	2	0	0	0	8
NNE	0	4	2	0	0	0	6
NE	0	3	0	0	0	0	3
ENE	4	7	0	0	0	0	11
E	2	1	0	0	0	0	3
ESE	1	4	0	0	0	0	5
SE	1	1	0	0	0	0	2
SSE	3	3	0	0	0	0	6
S	1	3	1	0	0	0	5
SSW	0	0	2	0	0	0	2
SW	0	0	3	2	0	0	5
WSW	0	2	2	0	0	0	4
W	1	3	1	0	0	0	5
WNW	2	2	0	0	0	0	4
NW	0	8	0	0	0	0	8
NNW	1	6	4	0	0	0	11
Variable	0	0	0	0	0	0	0
Total	16	53	17	2	0	0	88

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	11	12	0	0	0	25
NNE	0	34	27	0	0	0	61
NE	4	38	14	0	0	0	56
ENE	10	22	0	0	0	0	32
E	11	7	0	0	0	0	18
ESE	12	7	0	0	0	0	19
SE	6	10	0	0	0	0	16
SSE	2	14	3	0	0	0	19
S	0	17	8	0	0	0	25
SSW	0	4	25	4	0	0	33
SW	2	7	12	2	0	0	23
WSW	1	5	4	0	0	0	10
W	5	2	2	0	0	0	9
WNW	4	7	0	0	0	0	11
NW	7	7	4	1	0	0	19
NNW	7	15	6	0	0	0	28
Variable	0	0	0	0	0	0	0
Total	73	207	117	7	0	0	404

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	9	18	1	0	0	0	28
NNE	14	37	1	0	0	0	52
NE	22	18	0	0	0	0	40
ENE	35	9	0	0	0	0	44
E	36	1	0	0	0	0	37
ESE	22	22	0	0	0	0	44
SE	7	17	0	0	0	0	24
SSE	12	65	10	0	0	0	87
S	7	65	30	0	0	0	102
SSW	1	17	24	0	0	0	42
SW	3	13	6	0	0	0	22
WSW	7	13	2	0	0	0	22
W	11	14	2	0	0	0	27
WNW	17	10	0	0	0	0	27
NW	13	9	1	0	0	0	23
NNW	12	7	0	0	0	0	19
Variable	0	0	0	0	0	0	0
Total	228	335	77	0	0	0	640

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	14	3	0	0	0	0	17
NNE	10	3	0	0	0	0	13
NE	10	0	0	0	0	0	10
ENE	13	0	0	0	0	0	13
E	27	0	0	0	0	0	27
ESE	28	10	0	0	0	0	38
SE	13	14	0	0	0	0	27
SSE	14	13	0	0	0	0	27
S	4	7	0	0	0	0	11
SSW	2	11	0	0	0	0	13
SW	2	6	1	0	0	0	9
WSW	5	6	0	0	0	0	11
W	11	2	0	0	0	0	13
WNW	8	0	0	0	0	0	8
NW	13	0	0	0	0	0	13
NNW	7	1	0	0	0	0	8
Variable	0	0	0	0	0	0	0
Total	181	76	1	0	0	0	258

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	0	0	0	0	0	3
NNE	7	1	0	0	0	0	8
NE	5	0	0	0	0	0	5
ENE	0	0	0	0	0	0	0
E	11	1	0	0	0	0	12
ESE	7	2	0	0	0	0	9
SE	2	2	0	0	0	0	4
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	4	0	0	0	0	4
SW	2	0	0	0	0	0	2
WSW	5	5	0	0	0	0	10
W	7	0	0	0	0	0	7
WNW	8	0	0	0	0	0	8
NW	9	0	0	0	0	0	9
NNW	1	0	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	67	15	0	0	0	0	82

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	8	0	0	0	12
NNE	0	4	7	3	0	0	14
NE	1	5	9	7	0	0	22
ENE	0	12	8	0	0	0	20
E	3	8	8	3	0	0	22
ESE	0	8	6	1	0	0	15
SE	1	13	2	2	0	0	18
SSE	1	24	10	0	0	0	35
S	0	21	31	6	0	0	58
SSW	0	6	14	27	2	0	49
SW	0	7	10	11	2	0	30
WSW	0	9	11	7	0	0	27
W	1	28	16	9	0	0	54
WNW	0	23	17	8	1	0	49
NW	1	11	23	10	0	0	45
NNW	0	20	11	6	0	0	37
Variable	0	0	0	0	0	0	0
Total	8	203	191	100	5	0	507

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 4
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	1	0	0	0	5
NNE	0	6	2	2	0	0	10
NE	3	1	6	6	0	0	16
ENE	1	3	3	0	0	0	7
E	1	5	2	0	0	0	8
ESE	1	2	0	0	0	0	3
SE	0	5	0	0	0	0	5
SSE	1	2	1	0	0	0	4
S	0	2	2	1	0	0	5
SSW	0	1	5	2	1	0	9
SW	0	2	1	2	3	0	8
WSW	0	2	1	1	0	0	4
W	2	4	2	1	0	0	9
WNW	1	0	0	0	0	0	1
NW	0	2	3	3	0	0	8
NNW	1	5	3	0	0	0	9
Variable	0	0	0	0	0	0	0
Total	11	46	32	18	4	0	111

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	4	1	0	0	9
NNE	0	3	0	1	0	0	4
NE	0	1	2	1	0	0	4
ENE	0	7	4	0	0	0	11
E	2	3	1	0	0	0	6
ESE	1	1	1	1	0	0	4
SE	0	2	0	0	0	0	2
SSE	2	2	4	0	0	0	8
S	0	2	1	1	0	0	4
SSW	0	0	1	1	0	0	2
SW	0	0	1	2	2	0	5
WSW	0	0	3	1	0	0	4
W	0	2	1	1	0	0	4
WNW	0	2	2	0	0	0	4
NW	0	2	5	3	0	0	10
NNW	0	5	3	1	0	0	9
Variable	0	0	0	0	0	0	0
Total	5	36	33	14	2	0	90

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 1
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	11	10	6	1	0	28
NNE	2	9	16	19	0	0	46
NE	0	9	33	21	0	0	63
ENE	2	11	23	1	0	0	37
E	3	10	10	0	0	0	23
ESE	0	10	7	1	0	0	18
SE	0	12	7	1	0	0	20
SSE	0	4	10	5	0	0	19
S	0	2	13	7	0	0	22
SSW	0	1	7	24	11	0	43
SW	0	2	6	6	0	0	14
WSW	0	2	4	3	0	0	9
W	0	4	2	1	0	0	7
WNW	2	2	5	2	0	0	11
NW	0	7	7	4	4	1	23
NNW	4	5	9	3	0	0	21
Variable	0	0	0	0	0	0	0
Total	13	101	169	104	16	1	404

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	9	16	0	0	0	25
NNE	1	8	25	4	0	0	38
NE	0	7	37	3	0	0	47
ENE	2	16	28	0	0	0	46
E	0	21	26	1	0	0	48
ESE	0	5	18	14	0	0	37
SE	0	6	21	6	0	0	33
SSE	0	9	30	33	1	0	73
S	0	7	26	53	2	0	88
SSW	1	2	27	41	2	0	73
SW	1	4	11	5	3	0	24
WSW	1	4	8	2	0	0	15
W	2	13	16	4	0	0	35
WNW	0	4	14	3	0	0	21
NW	0	10	12	3	0	0	25
NNW	2	6	13	0	0	0	21
Variable	0	0	0	0	0	0	0
Total	10	131	328	172	8	0	649

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 1
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	10	1	0	0	15
NNE	0	4	13	0	0	0	17
NE	0	4	11	0	0	0	15
ENE	2	13	6	0	0	0	21
E	0	8	14	2	0	0	24
ESE	0	1	16	11	0	0	28
SE	0	3	21	5	0	0	29
SSE	0	9	17	3	0	0	29
S	1	3	18	3	0	0	25
SSW	1	3	19	3	0	0	26
SW	0	3	2	5	0	0	10
WSW	1	1	0	3	0	0	5
W	0	0	4	4	0	0	8
WNW	1	1	13	2	0	0	17
NW	0	1	4	1	0	0	6
NNW	0	1	9	1	0	0	11
Variable	0	0	0	0	0	0	0
Total	6	59	177	44	0	0	286

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: July - September 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	5	3	0	0	0	8
NNE	1	4	3	0	0	0	8
NE	0	6	2	3	0	0	11
ENE	2	0	1	0	0	0	3
E	2	1	5	2	0	0	10
ESE	1	4	5	2	0	0	12
SE	3	3	8	2	0	0	16
SSE	2	9	1	0	0	0	12
S	6	2	1	0	0	0	9
SSW	1	3	1	1	0	0	6
SW	4	5	2	1	0	0	12
WSW	3	2	2	1	0	0	8
W	0	5	2	4	0	0	11
WNW	1	1	6	2	0	0	10
NW	2	0	3	2	0	0	7
NNW	0	1	5	3	0	0	9
Variable	0	0	0	0	0	0	0
Total	28	51	50	23	0	0	152

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 3
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	3	0	0	0	6
NNE	0	1	3	1	0	0	5
NE	0	6	7	0	0	0	13
ENE	0	1	0	0	0	0	1
E	0	1	0	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	1	0	0	0	0	1
S	0	5	3	1	0	0	9
SSW	0	3	13	7	0	0	23
SW	0	1	11	0	0	0	12
WSW	0	3	8	0	0	0	11
W	0	13	13	0	2	1	29
WNW	0	8	18	4	0	0	30
NW	1	6	9	1	0	0	17
NNW	0	2	9	4	0	0	15
Variable	0	0	0	0	0	0	0
Total	1	54	97	18	2	1	173

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	2	0	0	0	3
NNE	0	1	3	0	0	0	4
NE	0	2	5	0	0	0	7
ENE	0	1	2	0	0	0	3
E	0	0	0	0	0	0	0
ESE	0	1	0	0	0	0	1
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	3	0	2	0	0	5
SSW	0	2	8	4	0	0	14
SW	1	1	5	6	0	0	13
WSW	0	7	4	1	0	0	12
W	1	6	6	2	1	0	16
WNW	0	4	3	2	0	0	9
NW	0	6	1	1	0	0	8
NNW	0	1	1	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	2	36	40	18	1	0	97

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	1	2	3	0	0	0	6
NNE	0	1	0	0	0	0	1
NE	0	2	5	0	0	0	7
ENE	0	1	0	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	1	0	0	0	0	1
SE	0	2	1	0	0	0	3
SSE	0	0	0	0	0	0	0
S	0	2	2	0	0	0	4
SSW	0	0	1	4	3	0	8
SW	0	0	3	2	0	0	5
WSW	1	4	5	1	0	0	11
W	1	7	2	3	2	0	15
WNW	0	8	3	1	0	0	12
NW	0	3	1	0	0	0	4
NNW	1	3	3	1	0	0	8
Variable	0	0	0	0	0	0	0
Total	4	36	29	12	5	0	86

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	11	31	6	1	0	52
NNE	7	8	7	1	0	0	23
NE	3	26	7	0	0	0	36
ENE	10	41	2	0	0	0	53
E	10	39	1	0	0	0	50
ESE	3	14	0	0	0	0	17
SE	3	10	30	2	0	0	45
SSE	0	16	30	3	0	0	49
S	1	9	31	9	1	0	51
SSW	0	3	23	38	1	0	65
SW	0	10	37	32	1	0	80
WSW	2	9	23	17	3	0	54
W	8	31	45	23	9	0	116
WNW	2	24	32	20	0	0	78
NW	4	19	13	5	0	0	41
NNW	4	25	47	3	0	0	79
Variable	0	0	0	0	0	0	0
Total	60	295	359	159	16	0	889

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	6	14	6	0	0	0	26
NNE	6	17	1	0	0	0	24
NE	15	6	0	0	0	0	21
ENE	14	1	0	0	0	0	15
E	12	1	0	0	0	0	13
ESE	10	7	0	0	0	0	17
SE	3	11	9	0	0	0	23
SSE	3	16	15	0	0	0	34
S	2	62	50	13	0	0	127
SSW	0	14	44	32	4	0	94
SW	1	15	23	9	0	0	48
WSW	7	36	7	1	0	0	51
W	17	33	11	1	0	0	62
WNW	26	49	12	2	0	0	89
NW	13	19	0	0	0	0	32
NNW	7	10	11	0	0	0	28
Variable	0	0	0	0	0	0	0
Total	142	311	189	58	4	0	704

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	6	0	0	0	0	0	6
NNE	2	0	0	0	0	0	2
NE	3	0	0	0	0	0	3
ENE	4	0	0	0	0	0	4
E	6	0	0	0	0	0	6
ESE	3	0	0	0	0	0	3
SE	4	3	0	0	0	0	7
SSE	1	4	0	0	0	0	5
S	2	3	0	0	0	0	5
SSW	3	2	0	0	0	0	5
SW	1	4	4	0	0	0	9
WSW	1	27	0	0	0	0	28
W	13	16	0	0	0	0	29
WNW	34	4	0	0	0	0	38
NW	7	2	0	0	0	0	9
NNW	2	0	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	92	65	4	0	0	0	161

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 34 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	0	0	0	0	0	4
NNE	2	0	0	0	0	0	2
NE	3	0	0	0	0	0	3
ENE	1	0	0	0	0	0	1
E	3	0	0	0	0	0	3
ESE	1	0	0	0	0	0	1
SE	2	0	0	0	0	0	2
SSE	0	0	0	0	0	0	0
S	1	0	0	0	0	0	1
SSW	0	0	0	0	0	0	0
SW	0	0	2	0	0	0	2
WSW	2	3	0	0	0	0	5
W	6	4	0	0	0	0	10
WNW	18	0	0	0	0	0	18
NW	11	0	0	0	0	0	11
NNW	2	0	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	56	7	2	0	0	0	65

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 0

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Extremely Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	3	0	0	5
NNE	0	0	1	3	0	0	4
NE	0	0	9	4	1	0	14
ENE	0	0	1	0	0	0	1
E	0	0	1	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	1	0	0	0	0	1
S	0	2	7	2	1	0	12
SSW	0	0	2	14	8	0	24
SW	1	0	5	3	0	0	9
WSW	0	2	6	1	0	0	9
W	0	5	17	5	0	3	30
WNW	0	5	13	9	0	4	31
NW	0	3	7	10	1	4	25
NNW	0	1	4	2	0	0	7
Variable	0	0	0	0	0	0	0
Total	1	19	75	56	11	11	173

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 2

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Moderately Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
	Wind Speed (in mph)						
N	0	0	0	1	0	0	1
NNE	0	1	0	2	0	0	3
NE	0	0	2	5	0	0	7
ENE	0	1	0	2	0	0	3
E	0	0	0	0	0	0	0
ESE	0	1	0	0	0	0	1
SE	0	0	0	0	0	0	0
SSE	0	1	0	0	0	0	1
S	0	1	1	1	3	0	6
SSW	0	1	2	6	4	2	15
SW	0	2	5	1	3	0	11
WSW	0	5	7	0	1	0	13
W	0	4	6	2	0	2	14
WNW	0	0	5	0	1	2	8
NW	0	3	2	3	1	0	9
NNW	0	2	0	3	0	0	5
Variable	0	0	0	0	0	0	0
Total	0	22	30	26	13	6	97

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 2

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Slightly Unstable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	0	3	0	0	5
NNE	0	1	0	0	0	0	1
NE	0	1	0	6	0	0	7
ENE	0	0	1	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	0	1	0	0	0	1
SE	0	0	3	0	0	0	3
SSE	0	0	0	0	0	0	0
S	0	1	2	1	0	0	4
SSW	0	0	1	2	3	4	10
SW	0	1	1	2	1	0	5
WSW	1	4	3	3	1	0	12
W	1	1	3	1	2	3	11
WNW	0	2	6	2	2	0	12
NW	1	2	3	1	0	0	7
NNW	0	3	1	2	1	0	7
Variable	0	0	0	0	0	0	0
Total	3	18	25	23	10	7	86

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 2

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Neutral - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	8	5	24	3	0	42
NNE	0	8	4	5	1	0	18
NE	1	5	19	8	0	0	33
ENE	2	11	30	7	0	0	50
E	1	13	42	6	0	0	62
ESE	1	0	12	4	0	0	17
SE	2	0	11	22	18	1	54
SSE	0	4	9	22	8	1	44
S	0	4	4	24	12	3	47
SSW	0	0	6	22	44	13	85
SW	1	3	20	21	15	2	62
WSW	2	3	15	16	15	9	60
W	3	14	16	40	16	14	103
WNW	1	6	18	21	13	11	70
NW	3	6	19	18	9	5	60
NNW	0	10	30	36	1	4	81
Variable	0	0	0	0	0	0	0
Total	19	95	260	296	155	63	888

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 1
Hours of missing stability measurements in all stability classes: 2

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Slightly Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	9	17	4	0	0	31
NNE	0	7	11	1	0	0	19
NE	0	3	15	3	0	0	21
ENE	1	3	8	0	0	0	12
E	2	8	4	0	0	0	14
ESE	0	5	11	3	0	0	19
SE	2	1	9	6	6	0	24
SSE	0	4	7	28	2	0	41
S	0	1	11	53	24	7	96
SSW	0	1	20	61	50	11	143
SW	0	6	8	12	2	0	28
WSW	0	6	16	23	2	2	49
W	1	9	14	18	1	0	43
WNW	0	15	31	32	6	1	85
NW	2	4	35	11	0	0	52
NNW	0	5	9	16	0	0	30
Variable	0	0	0	0	0	0	0
Total	9	87	226	271	93	21	707

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 4
Hours of missing stability measurements in all stability classes: 2

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Moderately Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Speed (in mph)

Wind Direction	1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	6	0	0	0	9
NNE	0	5	3	0	0	0	8
NE	0	2	5	0	0	0	7
ENE	1	1	1	0	0	0	3
E	1	0	2	0	0	0	3
ESE	0	1	2	0	0	0	3
SE	0	0	3	0	0	0	3
SSE	0	0	2	1	0	0	3
S	0	3	4	1	0	0	8
SSW	0	3	6	1	0	0	10
SW	0	0	1	4	2	0	7
WSW	1	0	4	8	0	0	13
W	0	3	11	19	0	0	33
WNW	0	3	13	2	0	0	18
NW	1	4	17	6	0	0	28
NNW	0	5	10	0	0	0	15
Variable	0	0	0	0	0	0	0
Total	4	33	90	42	2	0	171

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 2
Hours of missing stability measurements in all stability classes: 2

Braidwood Nuclear Station

Period of Record: October - December 2005
Stability Class - Extremely Stable - 199Ft-30Ft Delta-T (F)
Winds Measured at 203 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	8	0	0	0	8
NNE	0	1	3	3	0	0	7
NE	1	0	1	0	0	0	2
ENE	0	1	1	0	0	0	2
E	1	1	1	0	0	0	3
ESE	1	2	1	0	0	0	4
SE	0	1	0	0	0	0	1
SSE	0	1	0	0	0	0	1
S	2	1	0	0	0	0	3
SSW	0	0	2	0	0	0	2
SW	2	2	0	1	1	0	6
WSW	0	1	1	0	0	0	2
W	0	1	1	7	0	0	9
WNW	1	1	2	1	0	0	5
NW	0	1	11	1	0	0	13
NNW	0	1	6	2	0	0	9
Variable	0	0	0	0	0	0	0
Total	8	15	38	15	1	0	77

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 2

ATTACHMENT 2

Assessment of Offsite Doses from Inadvertent Releases of Water from the Blowdown Line at Braidwood Station

TR-01-2006
DMA-TR-27

TECHNICAL REPORT

Assessment of Offsite Doses from Inadvertent Releases of Water from the Blowdown Line at Braidwood Station

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William H. Barley, CHP
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March 2006

Approved by: John S. Moser
Radiation Protection Manager, Braidwood Station

3/28/06

John S. Moser **Date**

Independent Review by: John W. Poston, Sr., PhD
Texas A&M University

Prepared for

Exelon.

Exelon Nuclear
Braidwood Station
Braidwood, Illinois

LIMITATIONS

This technical report was prepared by independent technical experts in accordance with our signed agreements with Exelon Nuclear. Representatives of *Dade Moeller & Associates, Inc.*, *Radiation Safety & Control Services,* and *Bartlett Nuclear, Inc.* prepared this work based on information provided by Exelon Nuclear. This report reflects information available at the time of document submittal.

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
CFR	Code of Federal Regulations
cm	centimeter
d	day
ft	ft
g	gram
gal	gallon
GI-LLI	gastrointestinal/lower large intestine
gph	gallons per hour
gpm	gallons per minute
hr	hour
kg	kilogram
L	liter
lb	pound
LLD	lower limit of detection
m	meter
MDA	minimum detectable activity
mL	milliliter
mrem	millirem
mSv	millisievert
N/A	Not applicable
NCRP	National Council on Radiation Protection and Measurements
NIRL	negligible individual risk level
ODCM	Offsite Dose Calculation Manual
oz	ounce
pCi	picocurie
RG	Regulatory Guide
VB	vacuum breaker
yr	year
µCi	microcurie

SUMMARY

Since 1996 the Braidwood Station has experienced several inadvertent releases of cooling water from vacuum breaker valves in the blowdown line that returns water from the cooling lake to the Kankakee River. These releases contained tritium (hydrogen-3) and much smaller concentrations of other radionuclides. Groundwater monitoring initiated in 2005 determined the extent and concentration of tritium groundwater plumes originating at vacuum breakers on and off the site. This report assesses the potential offsite radiation doses that could have been received by members of the public from exposure to tritium that reached the offsite environment around the Braidwood Station.

Conservative exposure scenarios were evaluated to develop bounding dose estimates—the highest reasonable radiation doses that could have been received by members of public. These conservative scenarios were then evaluated in more detail to develop realistic estimates of dose. The methodology of U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 was used as the basis for estimating doses from all scenarios.

The estimated bounding dose to a member of the public was about 0.16 mrem/yr from ingestion of drinking water from a residential groundwater well containing tritium from a vacuum breaker release. The highest realistic estimates of radiation dose were from the same drinking water scenario. The estimated maximum realistic dose was 0.068 mrem/yr with an average or expected value about one-half that or 0.034 mrem/yr. When doses from the realistic exposure scenarios were summed, the maximum dose was estimated to be 0.072 mrem/yr. Table E-1 lists these dose estimates.

The estimated doses from the vacuum breaker releases at the Braidwood Station are well below the design objective of 6 mrem/yr for the two-unit site provided in Title 10 of the Code of Federal Regulations Part 50 (10 CFR 50, Appendix I). The doses are even further below the 100 mrem/yr regulatory dose limit for a member of the public provided in 10 CFR 20, Subpart D. The estimated radiation dose represents a negligible increased risk—less than 0.1 percent of the risk from natural background radiation—to members of the public.

Table S-1. Doses to the public from vacuum breaker releases (mrem/yr).

Exposure Scenario	Minimum	Average (expected)	Maximum
Drinking well water (2 adults)	~ 0	0.034[1]	0.068[2]
Eating fish from Exelon Pond (multiple individuals)	0	0.0011	0.0034
Maximum individual summed dose	~ 0	< 0.04	< 0.072

1. Based on average individual drinking water ingestion rate of 370 L/yr.
2. Based on maximum individual drinking water ingestion rate of 730 L/yr.

Assessment of Offsite Doses from Inadvertent Releases of Water from the Blowdown Line at Braidwood Station

1. INTRODUCTION

The Braidwood Station is located in Will County in northeastern Illinois. It has two Westinghouse pressurized light-water reactors that each have a net generating capacity of approximately 1,200 megawatts of electricity. Unit 1 began commercial operation in July 1988 and Unit 2 followed in October 1988. Since 1996, the Braidwood Station has experienced several inadvertent releases of cooling water discharged from vacuum breaker (VB) valves in the blowdown line that returns water from the cooling lake to the Kankakee River. These releases contained tritium (hydrogen-3, or ^{3}H) and much smaller concentrations of other radionuclides. Groundwater monitoring initiated in 2005 determined the extent and concentration of tritium groundwater plumes originating on the site at VB-1, VB-2, VB-3 and smaller plumes originating off the site at VB-4, VB-6, and VB-7. No tritium has been detected in offsite groundwater around VB-5, VB-8, VB-9, VB-10, and VB-11.

This report assesses the potential offsite radiation doses that could have been received by members of the public from exposure to tritium that reached the offsite environment around the Braidwood Station. Tritium has been detected off the site in shallow groundwater and in the Exelon Pond, which lies northeast of the station and is currently owned by Exelon Corporation.

Section 2 of this report provides background information on releases of cooling water from the VBs and on the locations and concentrations of tritium discovered in offsite groundwater and the Exelon Pond. The section also provides a discussion of the regulatory framework under which the doses to the public were evaluated.

Section 3 describes the methods and calculations used to estimate the potential of doses. The equations are taken from the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977).

Section 4 presents bounding estimates of the radiation dose that members of the public could have received from exposure to tritium. The bounding estimates are the highest reasonable radiation doses that could have been received by members of public. The exposure scenarios developed for and described in this section could have resulted in public dose. These scenarios may or may not have actually occurred. In addition, this section hypothesizes potential exposure to radionuclides other than tritium in a limited number of scenarios, even though none of these other radionuclides has been detected off the site.

Section 5 provides more realistic estimates of radiation dose that members of the public could have received. This section describes the application of a graded approach to the analysis in which (1) the broad umbrella of bounding exposure scenarios in the previous section are more closely evaluated and unrealistic scenarios are eliminated from further consideration, (2) exposure scenarios that could have occurred but would result in extremely low doses and therefore negligible risk under bounding conditions are also eliminated from further consideration, and (3) the remaining exposure scenarios evaluate the actual exposure that could have occurred using assumptions and parameter values that more closely reflect the actual environmental conditions, characteristics, and lifestyles of nearby residents.

Section 6.0 presents report conclusions. It compares the calculated realistic dose estimates to the applicable regulatory limit and to the background radiation dose.

2. BACKGROUND

As noted in Section 1, the Braidwood Station has experienced several inadvertent releases of cooling water from VB valves in the blowdown line that returns water from the cooling lake to the Kankakee River. Groundwater monitoring initiated in 2005 determined the extent and concentration of tritium groundwater plumes from onsite valves VB-1, VB-2, and VB-3 and sampled the groundwater around the offsite VBs. Smaller tritium groundwater plumes were discovered near VB-4, VB-6, and VB-7. This section provides background information to understand the source of the tritium releases and the extent and concentration of tritium in the groundwater that is a potential source of exposure to members of the public.

2.1 General Description

Figure 1 is a map showing the Braidwood Station layout and the blowdown line with VB-1, VB-2, and VB-3. Figure 2 shows the other VBs, where the blowdown line continues to the Kankakee River.

The blowdown line returns water from the station cooling lake back to the Kankakee River for the purposes of reducing the dissolved mineral concentration of the lake water. The cooling lake provides a heat sink for the main condensers. Because the lake is warm and has a large surface area, it loses much of its water to evaporation. Evaporation of the water concentrates dissolved and suspended minerals in the lake. High concentrations of dissolved minerals, especially calcium carbonate, can result in calcium deposits on the heat exchangers, reducing their performance. Water flows continuously through the blowdown line. Typical blowdown line flow rates were 10,000 to 12,000 gallons per minute (gpm) before August of 2003. Since then, the average flow rates have been increased to 20,000-25,000 gpm as a result of station modifications.

Tritium is formed in reactor coolant water during normal operating conditions when a neutron is captured by boron or lithium present in the coolant. Excess station water that contains tritium is collected in a liquid radioactive waste tank and periodically released to the blowdown line. These intermittent and noncontinuous releases are conducted under State and Federal permits. During normal operation the station releases a waste tank volume to the blowdown line about every 3 days, which can increase to daily releases during outages. The tritium concentration of water flowing within the blowdown line changes depending on whether there is a waste tank being discharged at the time of the measurement. When no tank is being discharged, the tritium concentration is the concentration of the cooling lake, essentially the ambient or background level. During a release, the tritium concentration of the line will be significantly higher. The average tritium concentration during releases can exceed 1 million pCi/L. This would also be the concentration as it enters the river, but before dilution in the river. This is an average of water flowing in the blowdown line for only the period that the waste tank is actually discharging to the blowdown line, which typically lasts from 1 to 5 hours. If a composite water sample was drawn by extracting a small continuous sample from the line over a longer period when multiple radioactive waste tank releases occurred, followed by longer periods of blowdown from the cooling lake, then the composite concentration would be much less than 1 million pCi/L and on the order of 40,000 to 100,000 pCi/L depending on the blowdown line flow. Because the tritium concentration in the blowdown line can vary greatly, it is important to recognize that a

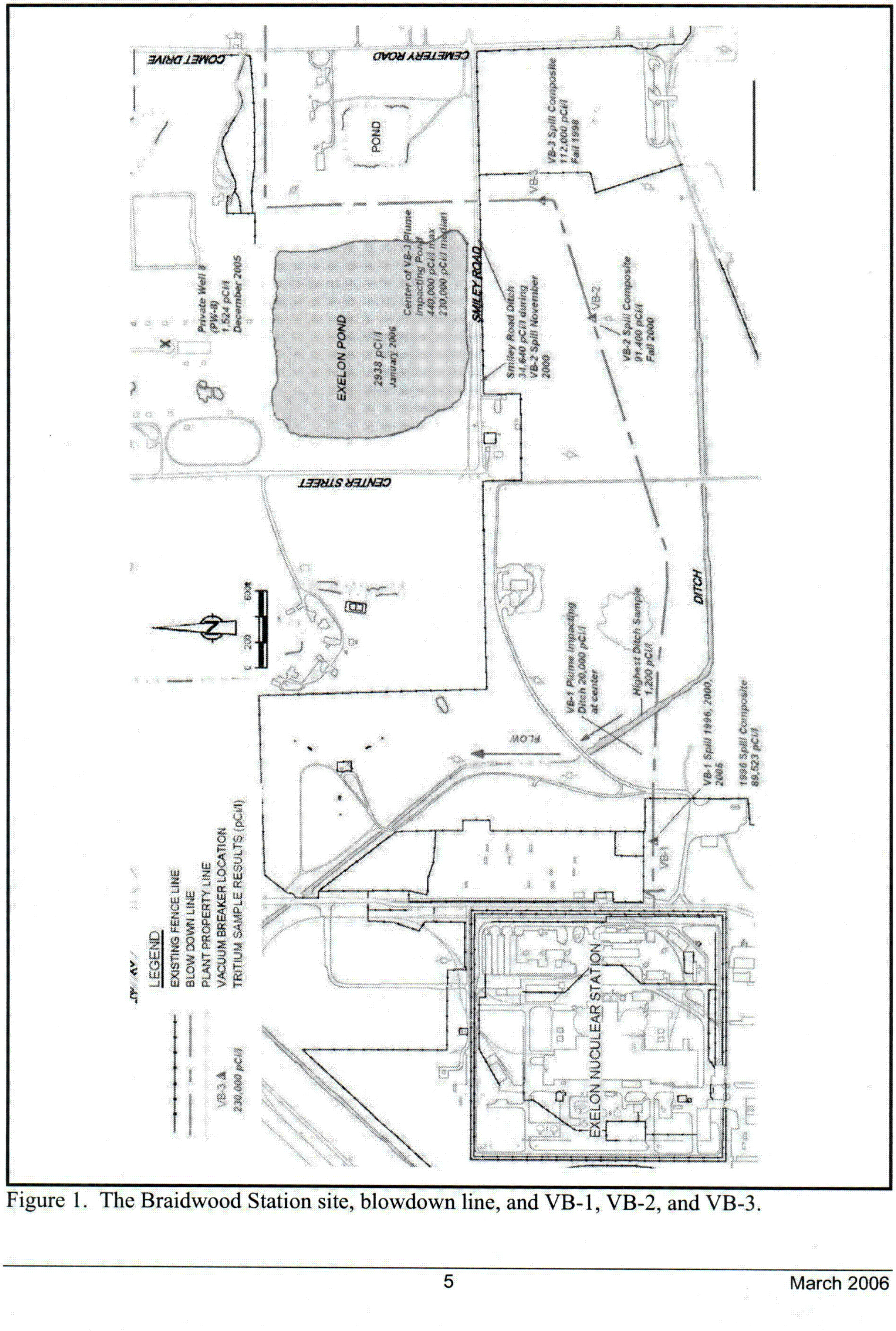

Figure 1. The Braidwood Station site, blowdown line, and VB-1, VB-2, and VB-3.

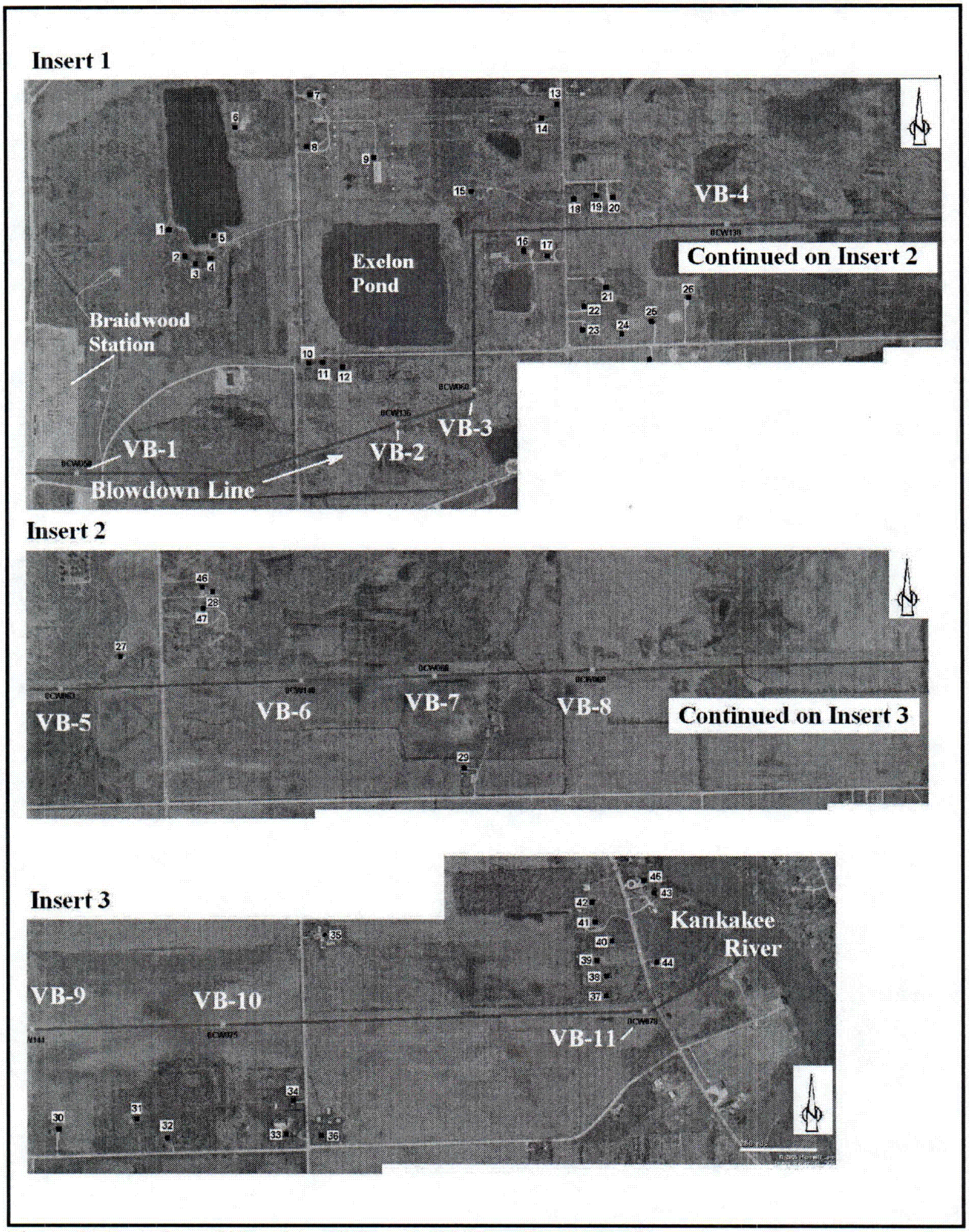

Figure 2. Location of blowdown line and all VBs to Kankakee River.

continuous VB leak would have an average concentration equal to the composite concentration of the blowdown line during the time the leak was active.

2.2 Groundwater Sampling

The first Exelon studies in the early spring of 2005 evaluated the presence or lack of tritium in surface water and groundwater. These initial studies included sampling private wells to the west of the site in the Village of Godley and sampling the perimeter ditch flow from east to southwest around the main generating station perimeter. Discovery of tritium above background concentrations in the perimeter ditch on the east side of the Braidwood Station property prompted a series of groundwater studies in the summer and fall of 2005. A comprehensive groundwater investigation program was implemented by Exelon in mid-November 2005 and is continuing. As part of the groundwater studies, and the overall site characterization program, Exelon has installed over 157 groundwater monitoring points at the site, collected surface water samples, and sampled 14 private wells on many occasions. A routine program of private well sampling and groundwater monitoring is currently on-going at the site. As of early March 2006, nearly 700 samples had been collected and analyzed. Table 1 lists a summary of selected groundwater sampling results that are directly relevant to the dose assessment documented in this report. These results reflect sampling in the shallow sand aquifer; shallow wells are from 11 to 21 ft below the ground surface and deep wells are from 21 to 41 ft below the ground surface. Figures 3 and 4 show groundwater monitoring and private well locations, as well as the various ponds around the site.

Table 1. Summary of selected tritium groundwater sampling results (pCi/L).[1]

Sample Location	Samples	Minimum	Median	Maximum
VB-1	20	< LLD[2]	206	22,928
VB-2	26	< LLD[2]	1,696	6,193
VB-3	23	< LLD[2]	19,605	108,736
VB-4	77	< LLD[2]	56	31,459
VB-5	9	< LLD[2]	22	112
VB-6	19	< LLD[2]	23	2,222
VB-7	25	< LLD[2]	38	2,776
VB-8	10	< LLD[2]	50	209
VB-9	10	< LLD[2]	31	109
VB-10	10	< LLD[2]	16	179
VB-11	9	< LLD[2]	44	92
Private wells (15)	25	< LLD[2]	38	1,524
Private well #8	3	1,151	1,367	1,524
Sampling well P13	14	217,122	226,251	442,990

1. Results through March 2, 2006.
2. Lower limit of detection (LLD) for the analytical laboratory is 200 pCi/L.

The groundwater sampling program was planned using knowledge of past onsite failures at VB-1, VB-2, and VB-3 (see Figure 1). Station records coupled with existing groundwater data indicate that the tritium detected in the groundwater in 2005 and 2006 is a result of past failures at these VB valves. There are specific identified events that can explain the levels of the tritium detected on and off the property in the vicinity of the site. Integrity testing of the blowdown line pipe and focused groundwater studies along the full length of the blowdown line at the site do not indicate that the line itself is the source of the tritium. Figures 3 and 4 show maps of the tritium groundwater plumes created by leaks at these VBs.

2.3 History of VB Releases

Exelon has identified and evaluated VB releases and determined that releases and detectable tritium groundwater concentrations have resulted from leaks at six valves (VB-1, VB-2, VB-3, VB-4, VB-6, and VB-7). Relatively large releases of tritium have occurred only from the three onsite VBs (VB-1, VB-2, and VB-3). Table 2 summarizes the blowdown line VB releases, including minor releases from other VB valves. The most significant events for VB-1, VB-2, and VB-3 are items 1, 3, and 4 in the table. The following paragraphs discuss additional information on the releases from VB-1, VB-2, and VB-3.

VB-1. A leak was discovered at VB-1 on December 1, 1996. The leak was in the 1-inch pipe to the air release valve. The valve had been previously inspected in June of 1995 at which time no leaks had been noticed. The line eventually broke and was repaired in June of 1997. Total leakage from VB-1 has been estimated at a maximum of 380,000 gal. Because the leakage occurred over many weeks, this leak would have included tank water releases containing tritium in addition to the lake water.

Later leaks from VB-1 occurred but resulted in no or minimal tritium releases. A leak was discovered on November 20, 2000, and is estimated to have been a maximum of 4 million gal. This leak contained no tritium because no tanks were discharged while the leak occurred. More recently, a leak was discovered on May 19, 2005, at the pilot (air-release) valve seat. The total leakage was estimated to be a maximum of 140 gal with the tritium concentration estimated to be the composite tritium concentration in the line during 2005.

VB-2. A leak was detected from VB-2 in November 2000 as a result of VB valve float failure. The float was repaired in December 2000. A resident reported flooding of the ditch adjacent to Braidwood Station in November 2000. The leakage was estimated at a maximum of 3 million gal. Analysis of plant release data for the 30 d before leak isolation revealed:

- The average tritium concentration during releases was 167,000 pCi/L.
- The highest tritium concentration in the pipeline during this period was 3,103,000 pCi/L.
- A continuous composite sample concentration would have been 91,400 pCi/L.

An important remedial aspect of the November 2000 release was that standing water from this leak was pumped back into the blowdown line, minimizing the quantity of tritium-containing water that reached the groundwater.

VB-3. A leak occurred from VB-3 in December 1998 as a result of a failed VB float; the float was repaired on December 4. The leaking valve was found due to flooding of the Smiley Road ditch on December 3. This valve had been previously inspected in December 1997, and no leakage was noted. The amount of leakage was not recorded but later estimated to be 2.9 million gal over a 30-d period. Analysis of plant release data for 1998 and the 30 d prior to isolating the leak revealed:

Table 2. Summary of releases from Braidwood Station blowdown line VB valves.

#	Date	Event	Leak Size	Other Radionuclides	Tritium Sample	Resolution
1	11/27/96	VB-1 leak	~250,000 gal	No sampling at time of spill.	No sampling at time of spill.	06/19/97 1" pipe to air release valve broke. Tritium plume was identified around VB-1 in 2006.
2	1/5/98	VB-2 leak	Small leak	No sampling at time of spill.	No sampling at time of spill. Tritium plume was identified in 2005.	11/08/00 replaced the float, replaced VB and isolation valve. Tritium plume was identified around VB-2 in 2005.
3	12/4/98	VB-3 leak - seat	Caused flooding ~ 3 million gal	04/26/01 Soil radioactivity above background.	No sampling at time of spill. Tritium plume was identified in 2005.	05/20/02 1" pipe to the air release valve broke due to corrosion. Guide post sheared weld off float. Entire VB replaced (July 2001). Tritium plume was identified around VB-3 in 2005.
4	11/6/00	VB-2 leak-seat	Caused flooding ~ 3 million gal	Radioactivity above background.	Tritium plume was identified around VB-2 in 2005.	11/06/00 Float broke on VB. Tritium plume was identified around VB-2 in 2005.
5	11/10/00	VB-6 leak seat	Small leak	No sampling at time of spill.	No sampling at time of spill. 2006 samples show no tritium in the groundwater	10/17/05 Valve assembly replaced. 2006 remediation sampling showed no tritium in the groundwater at this location.
6	11/20/00	VB-1 leak	VB lifting	11/20/00 samples no detectable activity.	Tritium sampling was performed no detectable activity.	11/21/00 Rebuilt valve internals. Tritium plume was identified around VB-1 in 2006.
7	6/18/01	VB-3 leak	½ gph leak from main VB	No sampling at time of spill.	Tritium plume was identified around VB-3 in 2005.	05/20/02 Rebuilt valve. Tritium plume was identified around VB-3 in 2005.
8	6/18/01	VB-9	Water in vault	Negative for other radionuclides.	No sampling at time of spill. No tritium in groundwater at this location reported in 2006.	No active leak. Attributed to groundwater. 2006 remediation sampling showed no tritium in the groundwater at this location.
9	6/18/01	VB-10	Water in vault	Negative for other radionuclides.	No sampling at time of spill.. No tritium in groundwater at this location in 2006.	No active leak. Attributed to groundwater. 2006 remediation sampling showed no tritium in the groundwater at this location.
10	6/18/01	VB-11	Water in vault	No sampling at time of spill.	No sampling at time of spill. No tritium in groundwater in 2006.	No active leak. Attributed to groundwater. 2006 remediation sampling showed no tritium in the groundwater at this location.
11	5/4/02	VB-3 Leak vent	Seepage	Sample showed above background activity.	No sampling at time of spill.	05/20/02 replaced air release valve. Tritium plume was identified around VB-3 in 2005.
12	8/20/03 8/27/03	VB-4 seat	1 gpm to vault, no flooding	Sample analysis detected no detectable Radioactivity	No sampling at time of spill. Tritium plume was identified in 2006.	9-9-03 replaced seat ring/float and top gasket. Tritium plume was identified around VB-4 in 2006.

Table 2 (Continued). Summary of releases from Braidwood Station blowdown line VB valves.

#	Date	Event	Leak Size	Other Radionuclides	Tritium Sample	Resolution
13	9/11/03	VB-4 seat	20-40 drops/min	No sampling at time of spill.	No sampling at time of spill. Tritium plume was identified in 2006.	10/22/03 No work performed. Leak determined to be from operating the system at low flow. Tritium plume was identified around VB-4 in 2006.
14	11/18/04	VB-8	Popping / leaking, small leak within pit	No sampling at time of spill.	No sampling at time of spill.	10/18/05 replaced valve assembly. 2006 remediation sampling showed no tritium in the groundwater at this location.
15	5/19/05	VB-1	20 drop per minute leak from the air release valve.	No sampling at time of spill.	Sampling was performed. Tritium plume was identified in 2006.	12/18/05 replaced the VB assembly. Tritium plume was identified around VB-1 in 2006.
16	5/24/05	VB-6 seat	Seepage from float / seat area with one foot of water in pit.	No sampling at time of spill.	Sampling was performed.	10/19/05 rebuilt main valve and replaced air release valve. 2006 remediation sampling showed no tritium in the groundwater at this location.
17	1/16/06	VB-7	Bushing failure. Not significant.	no detectable radioactivity	No detectable tritium in surface water from this leak. Prior to this leak, tritium above background & below EPA drinking water limit identified in 2006 in wells used to characterize conditions near this VB.	No resolution noted.

Information in this table provided by Exelon Nuclear.

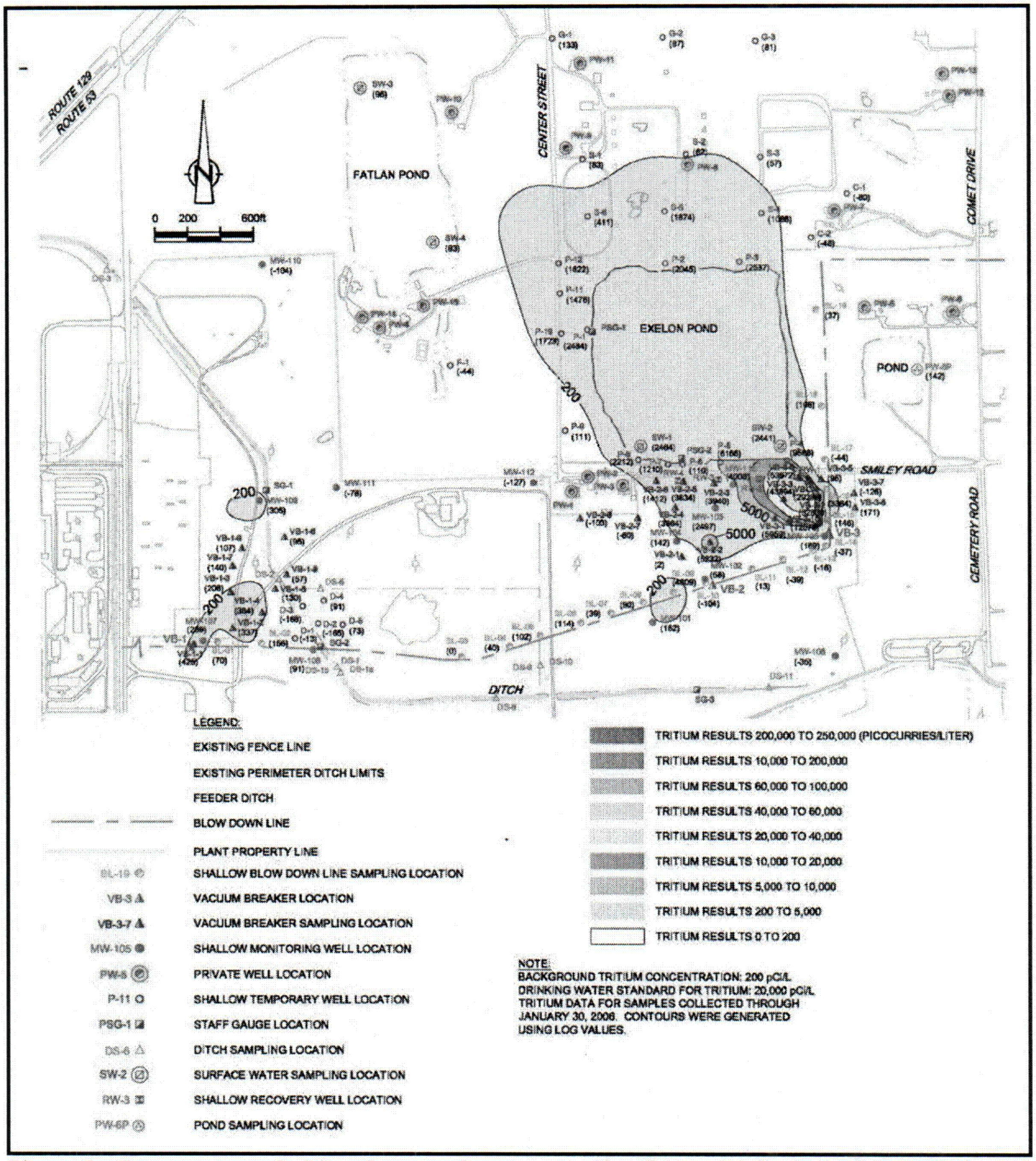

Figure 3. Contour map of tritium in groundwater at depths of 11 to 21 ft, shallow sand aquifer (January 2006).

- The average tritium concentration during releases was 624,000 pCi/L.
- The highest tritium concentration in the pipeline during this period was 1,852,000 pCi/L.
- A continuous composite sample concentration would have been 112,000 pCi/L.

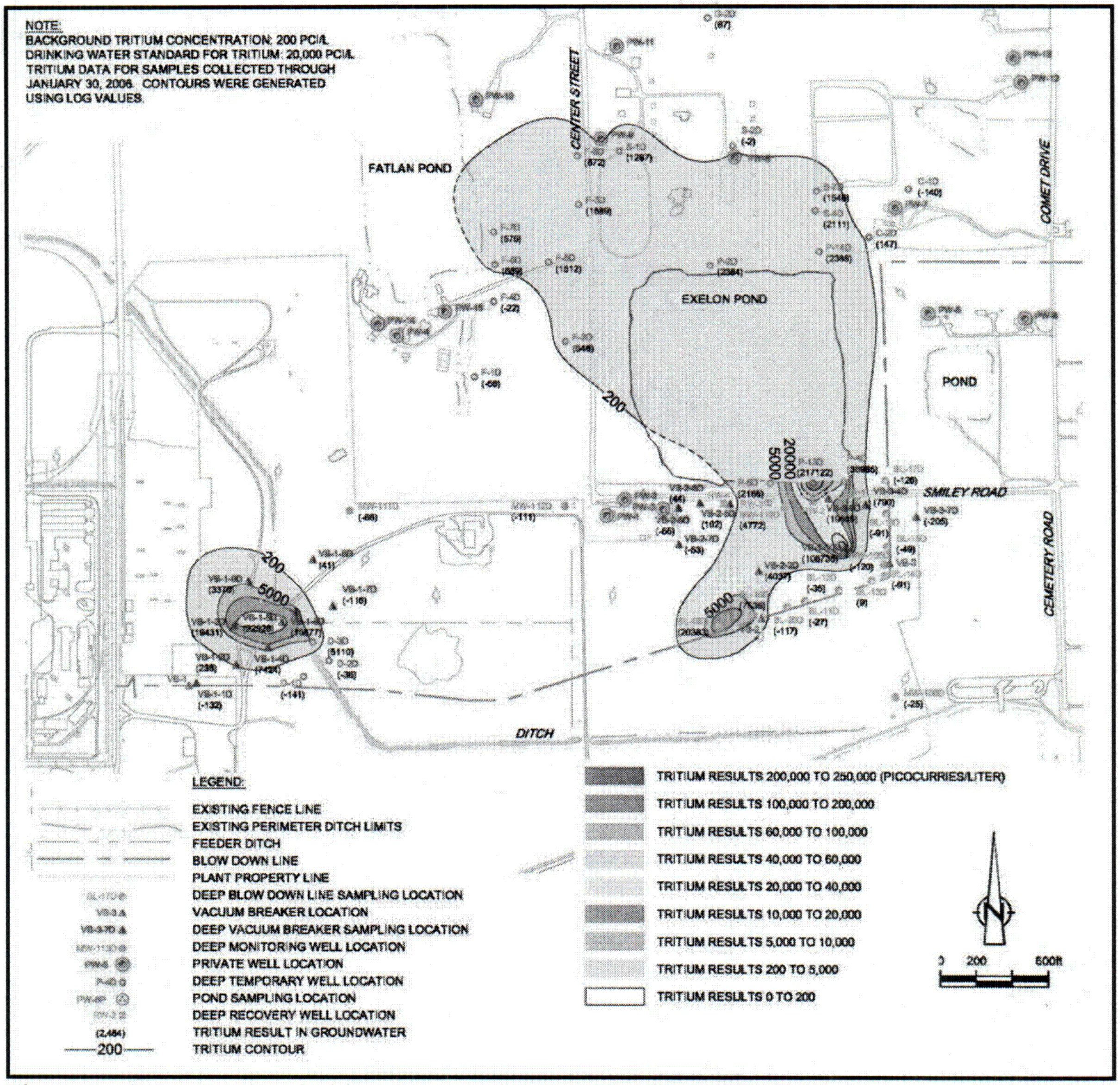

Figure 4. Contour map of tritium in groundwater at depths of 21 to 41 ft, shallow sand aquifer (January 2006).

Unlike the VB-2 release that occurred later, there was no remediation of standing water for this VB-3 release.

2.4 Groundwater Study

Exelon commissioned a groundwater and surface water study, the results of which are presented in a Focused Site Characterization Report (Conestoga-Rovers & Associates 2006). That report addressed releases from the three onsite valves (VB-1, VB-2, and VB-3) and is the source of much of the general information in earlier sections of this chapter. The report's key findings about the source, migration, and extent of tritium in groundwater at the site are:

- Groundwater flow in the shallow sand aquifer, where the tritium is detected, is from south to north.

- Groundwater flow is influenced by the perimeter ditch and by the ponds to the north and off the Braidwood Station property.

- The underlying deeper groundwater supply aquifers are separated from the tritium in the shallow sand aquifer by the regional Wendron Formation (clayey till) and shale formations including the 70-ft-thick Scales Shale.

- Groundwater flowing from the area on the Braidwood Station property south of Smiley Road discharges into Exelon Pond located to the north.

- The distribution of tritium in groundwater (and indicators in the cooling lake water) is consistent with historical releases from each of the three onsite VBs.

- The Braidwood Station records of valve failures and releases of water from the three onsite VBs correlate well with the current distribution of tritium in groundwater.

- Localized areas on the site where tritium has been detected above the drinking water standard (20,000 pCi/L) are shown in Figures 3 and 4. The main area is approximately 4.5 acres near Smiley Road at the southeast corner of the pond and just west of the blowdown line as it leaves the Station property.

- The data indicate tritium has migrated into the Exelon Pond north of Smiley Road and past the pond to a limited extent. The distance to the leading edge of this tritium plume from VB-2 and VB-3 is approximately 2,400 to 2,800 ft.

- Only one private well has had groundwater samples that were above background tritium concentrations; these were below the drinking water standard.

- In the main areas of groundwater affected by tritium (i.e., where concentrations are above the drinking water standard), the tritium is detected at higher concentrations at depth. The cause of the vertical differences (over a small saturated interval of 20 ft) is expected to be clean water recharge through precipitation. The depth to groundwater is at times less than 5 ft below ground surface and, as such, the upper water table will be regularly flushed with clean precipitation recharge.

- Deeper private water wells down gradient of the main tritium impacts were sampled and found to have background levels of tritium. This supports the role of the regional aquitards (e.g., Wendron clayey till and the Scales Shale) as vertical barriers to deeper migration of tritium. In addition, the lack of any steep downward vertical hydraulic gradients in the shallow sand aquifer would minimize vertical movement of tritium into the clay.

- Routine monitoring at key groundwater and surface water sample points since November 2005 has indicated stable or decreasing trends in tritium levels in the groundwater.

- The distribution of tritium in groundwater on the up gradient side (to the south) of the pond located north of Smiley Road and the distribution of tritium in groundwater down gradient or north of the pond indicates that the pond is acting to attenuate the elevated levels of tritium discharging into it along Smiley Road. The pond is mixing on a seasonal basis and therefore diluting the tritium that seeps into it on the south side. In other words, the pond has played a significant role in preventing higher concentrations of tritium from migrating north.

- Groundwater flow and tritium migration is expected to occur at a rate of 50 to 100 ft/yr within the upper sand aquifer.

2.5 Applicable Regulatory Requirements

A nuclear power plant must comply with two separate NRC regulatory requirements and one U.S. Environmental Protection Agency (EPA) requirement that pertain to radioactive effluents and doses to members of the public. First is a general regulation that applies to all radioactive material licensees, whether a power plant, hospital, or an industrial user. That regulation is contained in 10 CFR 20, Subpart D, *Radiation Dose Limits for Individual Members of the Public.* In this subpart, 10 CFR 20.1302(a) states:

> *The licensee shall make or cause to be made, as appropriate, surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in § 20.1301.*

The dose limit referred to in § 20.1301 is 100 mrem/yr. Demonstration requirements associated with doses to a member of the public are contained in 10 CFR 20.1302(b):

> *A licensee shall show compliance with the annual dose limit in § 20.1301 by--*
>
> *(1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or*
>
> *(2) Demonstrating that--*
>
> > *(i) The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to part 20; and*
> >
> > *(ii) If an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.*

The NRC regulation also recognizes an EPA rule. 10 CFR 20.1301(e) states:

> *In addition to the requirements of this part, a licensee subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR part 190 shall comply with those standards.*

EPA regulations at 40 CFR Part 190 require that any operations that are part of a nuclear fuel cycle provide reasonable assurance that doses to members of the public from all fuel-cycle activities are limited to 25 mrem/yr to the whole body. This is contained in 40 CFR 190, Subpart B, *Environmental Standards for the Uranium Fuel Cycle*, paragraph 190.10, which contains the standards for normal operations:

> *Operations covered by this subpart shall be conducted in such a manner as to provide reasonable assurance that:*
>
> *(a) The annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations.*
>
> *(b) The total quantity of radioactive materials entering the general environment from the entire uranium fuel cycle, per gigawatt-year of electrical energy produced by the fuel cycle, contains less than 50,000 curies of krypton-85, 5 millicuries of iodine-129, and 0.5 millicuries combined of plutonium-239 and other alpha-emitting transuranic radionuclides with half-lives greater than one year.*

In addition to the requirements of 10 CFR Part 20 and 40 CFR Part 190, nuclear power plants must also comply with 10 CFR Part 50 which governs nuclear power plant operations. The section on design objectives for equipment to control releases of radioactive material in effluents from nuclear power reactors [10 CFR 50.34(a)] states:

> *An application for a permit to construct a nuclear power reactor shall include a description of the preliminary design of equipment to be installed to maintain control over radioactive materials in gaseous and liquid effluents produced during normal reactor operations, including expected operational occurrences. In the case of an application filed on or after January 2, 1971, the application shall also identify the design objectives, and the means to be employed, for keeping levels of radioactive material in effluents to unrestricted areas as low as is reasonably achievable. The term "as low as is reasonably achievable [ALARA]" as used in this part means as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.* ***The guides set out in appendix I to this part provide numerical guidance on design objectives for light-water-cooled nuclear power reactors to meet the requirements that radioactive material in effluents released***

> ***to unrestricted areas be kept as low as is reasonably achievable. These numerical guides for design objectives and limiting conditions for operation are not to be construed as radiation protection standards.*** [Emphasis added.]

Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable [ALARA]" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents (10 CFR 50 Appendix I), states in part:

> *Sec. II. Guides on design objectives for light-water-cooled nuclear power reactors licensed under 10 CFR Part 50. The guides on design objectives set forth in this section may be used by an applicant for a permit to construct a light-water-cooled nuclear power reactor as guidance in meeting the requirements of § 50.34a(a). The applicant shall provide reasonable assurance that the following design objectives will be met.*
>
> *The calculated annual total quantity of all radioactive material above background[1] to be released from each light-water-cooled nuclear power reactor to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body or 10 millirems to any organ.*
>
> *SEC. IV. Guides on technical specifications for limiting conditions for operation for light-water-cooled nuclear power reactors licensed under 10 CFR part 50. The guides on limiting conditions for operation for light-water-cooled nuclear power reactors set forth below may be used by an applicant for a license to operate a light-water-cooled nuclear power reactor or a licensee who has submitted a certification of permanent cessation of operations under § 50.82(a)(1) as guidance in developing technical specifications under § 50.36a(a) to keep levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable.*
>
> *B. The licensee shall establish an appropriate surveillance and monitoring program to:*
>
> 1. *Provide data on quantities of radioactive material released in liquid and gaseous effluents to assure that the provisions of paragraph A of this section are met;*
> 2. *Provide data on measurable levels of radiation and radioactive materials in the environment to evaluate the relationship between quantities of radioactive material released in effluents and resultant radiation doses to individuals from principal pathways of exposure; and*
> 3. *Identify changes in the use of unrestricted areas (e.g., for agricultural purposes) to permit modifications in monitoring programs for evaluating doses to individuals from principal pathways of exposure.*

C. If the data developed in the surveillance and monitoring program described in paragraph B of Section III or from other monitoring programs show that the relationship between the quantities of radioactive material released in liquid and gaseous effluents and the dose to individuals in unrestricted areas is significantly different from that assumed in the calculations used to determine design objectives pursuant to Sections II and III, the Commission may modify the quantities in the technical specifications defining the limiting conditions in a license to operate a light-water-cooled nuclear power reactor or a license whose holder has submitted a certification of permanent cessation of operations under § 50.82(a)(1).

Appendix I therefore lays out a design objective based on the ALARA principle, while 10 CFR 50.34(a) clearly states this is not a regulatory limit. For comparison to dose estimates, the Braidwood site annual effluent reports use the design objective as a performance standard of 3 mrem/yr to the total body or 10 mrem/yr to any organ for each reactor.

Because the calculation of doses to members of the public from effluent releases is complex, and to ensure consistency of calculation between the NRC and licensees, the NRC developed a Regulatory Guide (RG) to be used when performing the calculations required by 10 CFR 20.1302 and 10 CFR 50, Appendix I. That document is RG 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I* (NRC 1977).

It is under this regulatory framework that this report documents the evaluation of potential radiation doses from water released from VB valves in the blowdown line of the Braidwood Station.

3. METHODOLOGY

This analysis estimated doses to members of the public from exposure scenarios (see Sections 4 and 5) calculated using the methods and equations of Regulatory Guide (RG) 1.109 (NRC 1977). These equations assume continuous exposure and equilibrium conditions. They are conservative estimates of exposures that could occur on a one-time or intermittent basis, and they are conservative for the scenarios evaluated in Section 4 and Section 5.

All of the exposure pathways evaluated in this report originate from the water released from the VB valves in the blowdown line; therefore, most of the scenarios involve what is considered the liquid effluent pathway described in RG 1.109. The exception is for the evaluation of external exposure from beta/gamma-emitting radionuclides deposited on the soil surface.

Some modifications to the RG 1.109 methods were made because the RG does not address all the potential exposure scenarios. For example, consumption of wild game animals that drink water and eat vegetation containing tritium required modifications to consumption rates and other parameters. These are explained in the sections below and in Section 4.

3.1 Ingestion Dose Conversion Factors for Tritium

Most of the exposure scenarios include ingestion of tritium as a major exposure pathway. The ingestion dose conversion factors are provided in RG 1.109 (NRC 1977). These dose factors are used for the bounding exposure scenarios in Section 4. The dose factors were subsequently revised for use in the LADTAP computer program, which is NRC-approved and published in NUREG/CR-4013 (Strenge et. al 1985). These factors are the basis of the tritium dose factors in the Exelon Offsite Dose Calculation Manual (ODCM). The newer NUREG/CR-4013 tritium ingestion dose factors are 57 percent lower than those in RG 1.109 because of updates that occurred in the calculational methodology; those are used in realistic dose scenarios in Section 5. Table 3 lists both sets of dose factors for the age groups in RG 1.109.

Table 3. Tritium ingestion dose conversion factors (mrem/pCi).

Age Group (*a*)	RG 1.109	NUREG/CR-4013	Ratio, NUREG/CR-4013 to RG 1.109
Adult	1.05E-07	5.99E-08	0.57
Teenager	1.06E-07	6.04E-08	
Child	2.03E-07	1.16E-07	
Infant	3.08E-07	1.76E-07	

3.2 Calculating Doses from Ingestion of Tritium

Doses from ingestion of tritium were calculated in accordance with RG 1.109, Equation A-1, which provides the generalized equation below for calculating doses to man from liquid pathways (NRC 1977).

Generalized Equation for Calculating Doses from Liquid Pathways

$$R_{aipj} = C_{ip} \, U_{ap} \, D_{aipj} \qquad \text{(Equation 1)}$$

where:

C_{ip} = concentration of nuclide *i* in the media of pathway *p*, pCi/L, pCi/kg, or pCi/m^2

D_{aipj} = the dose factor, specific to age group *a*, radionuclide *i*, pathway *p* and organ *j*. It represents the dose from intake of a radionuclide in mrem/pCi, or from exposure to a given concentration or radionuclide in sediment in mrem/hr per pCi/m^2

R_{aipj} = the annual dose to organ *j* of an individual of age group *a* from nuclide *i* via pathway *p*, mrem/yr

U_{ap} = the exposure time or intake rate (usage) associated with pathway *p* for age group *a*, hr/yr, L/yr, or kg/yr as appropriate

Because only the dose from one pathway at a time is being considered in these calculations, the subscript *p* can be eliminated as a designator. Similarly, only tritium is being considered, and the dose conversion factor for tritium is the same for all organs. Therefore, the designators *i* and *j* can be dropped from the equation, and the equation used to calculate dose from tritium ingestion becomes:

Simplified Equation for Calculating Dose from Ingestion of Tritium

$$R_a = C U_a D_a \qquad \text{(Equation 2)}$$

where:

C = concentration of tritium in the material ingested, pCi/L or pCi/kg
D_a = the dose factor, specific to age group *a*, mrem/pCi (see Equation 1 above)
R_a = the annual dose to an individual of age group *a*, mrem/yr
U_a = the intake rate (usage) associated for age group *a*, L/yr or kg/yr

Equation A-10 of RG 1.109 states that for tritium the concentration in vegetation (C_v) can be assumed to equal the concentration in water (C_w).

Tritium Equilibrium between Vegetation and Water

$$C_v(tritium) = C_w(tritium) \qquad \text{(Equation 3)}$$

Therefore, the dose is calculated using Equation 2 with the tritium concentration in the vegetation (e.g., garden produce) equal to the concentration in the water used to irrigate or water the garden. Table 4 lists the RG 1.109 age-specific usage factors (U_a) used in this report.

Table 4. Usage factors[1] (U_a) from Regulatory Guide 1.109 for maximum and average exposed individual in lieu of site-specific data.

Pathway	Age Group Maximum (Average) Consumption Rates			
	Infant	Child	Teen	Adult
Fruits, vegetables & grain (kg/yr)	–	520 (200)	630 (240)	520 (190)
Fish, fresh water (kg/yr)	–	6.9 (2.2)	16 (5.2)	21 (6.9)
Drinking Water (L/yr)	330 (–)	510 (260)	510 (260)	730 (370)

1. Only usage factors used in this report are presented. Maximum individual values are from RG 1.109, Table E-5; average individual values are from RG 1.109, Table E-4.

3.3 Calculating Doses from Eating Fish and Game Animals

The potential dose from eating fish from Exelon Pond was evaluated using the guidance in RG 1.109 (NRC 1977).

Calculating Dose from Fish Consumption

$$R_a = B\,C_w\,U_a\,D_a \qquad \text{(Equation 4)}$$

where:

- R_a = the annual dose to an individual of age group a, mrem/yr
- B = aquatic bioaccumulation factor, L/kg
- C_w = concentration of tritium in the pond, pCi/L
- U_a = the intake rate (usage) associated for age group a, kg/yr
- D_a = the dose factor, specific to age group a in mrem/pCi (see Equation 1 above)

The bioaccumulation factor (B) for freshwater fish taken from Table A-1 of RG 1.109 is 0.9 pCi/kg of fish per pCi/L of water. The bioaccumulation factor accounts for how the tritium water concentration (C_w) relates to the concentration in consumable parts of the fish. Table 4 lists the usage factors.

The dose was also calculated from consumption of game animals that consumed water contaminated with tritium. RG 1.109, Equation A-15, was used to calculate the concentration in a game animal that drinks tritiated water.

Calculating Hydrogen-3 Concentration in Meat from Contaminated Drinking Water

$$C_A = F_A\,C_w\,Q_{Aw} \qquad \text{(Equation 5)}$$

where:

- C_A = concentration of tritium in the animal, pCi/kg

F_A = Stable element transfer factor for meat, d/kg
C_w = concentration of tritium in the water the animal drinks, pCi/L
Q_{Aw} = the quantity of water the animal drinks daily, L/d

The tritium transfer factor of 0.012 d/kg, which is the activity concentration (pCi/kg) in meat per the intake (pCi/d) in vegetation or water by the animal, is from Table E-1 of RG 1.109. These transfer factors are for domestic animals but for purposes of this report are assumed to apply to game animals.

The quantity of water the game animal drinks was calculated as described below. The concentration of the tritium in the game animal (C_A) was then used in Equation 2 with the estimated quantity of meat consumed by the individual.

3.4 Calculating Water and Food Intake Rates for Game Animals

Water intake rates (U_w) of game animals were calculated using the guidance of DOE-STD-1153-2002 (DOE 2002). Equation 29 of this standard is for calculating the water intake of an animal based on its body mass:

$$T_{water} = 0.099 M^{0.90} \quad \text{(Equation 6)}$$

where:

T_{water} = animal water consumption rate, L/d

M = body mass of the animal, kg

The mass of feed an animal consumed daily (U_f) was based on an estimate of dry feed consumption equal to 3 to 5 percent of the wet body mass of the animal (Halls, date unavailable). The wet mass of the feed was assumed to be 5 times higher than the calculated dry weight. This estimate is conservative in comparison to the consumption values for white-tailed deer provided by Murphy (1970); whitetail deer are the principle potential game animal in the area. Consumption of Canadian or other species of geese was also considered.

3.5 Calculating Other Radionuclide Concentrations in the VB-3 Release

The bounding assessment of dose in Section 4 evaluates the possibility that radionuclides other than tritium might have been present in trace quantities in the liquid releases that flowed overland from the VB-3 vault, even though there is no supporting evidence for other radionuclides reaching the offsite environment. Concentrations of these other radionuclides were estimated based on available 1998 liquid release data and post-event soil sampling in the area around the VB-3 vault in 1998. The VB-3 area was not sampled until April 2001 when it was realized that potential soil contamination existed based on the 10 CFR 50.75(g) follow-up sampling results conducted in response to the November 2000 VB-2 spill.

The VB-3 spill occurred in late 1998 over an estimated 30 d. To determine the relative distribution of radionuclides in the spill water, the total activity of each nuclide for each tank release was summed from October of 1998 to January of 1999. Table 5 lists the results. In addition, Table 5 lists scaling factors for each nuclide relative to tritium and cobalt-60. The tritium scaling factor was used to estimate the quantities of other radionuclides in the spill water based on the estimated tritium concentration of the water. Cobalt-60 was the only radionuclide directly attributable to reactor operations that was detected in soil samples, and then only in the immediate vicinity of the vault where the leak originated (see Figure 5 below). Cesium-137 was also detected in soil samples but is likely present as part of the environmental baseline from atmospheric fallout.

The 10 CFR 50.75(g) file from which the data were obtained described sample grids with low but detectable levels of cesium-137 as clean (Figure 5). Regardless of the origin, cesium-137 was included in applicable dose calculations. Similarly, the reported minimum detectable activities (MDAs) for cobalt-60 and cesium-137 from the sample analysis results were included in the calculation of the average soil concentrations in the VB-3 spill area. The approach overestimates the cobalt-60 and cesium-137 soil concentrations which could have been present in the area. Cobalt-60 scaling factors from Table 5 were used to estimate the concentrations of the other radionuclides in the soil based on the cobalt-60 concentration of soil samples.

Table 5. Total radioactivity released from October through January 1998.

Nuclide	Activity µCi	Fraction of Activity (excluding H-3)	H-3 Scaling Factor	Co-60 Scaling Factor
H-3	3.7 E+8	(not included)	1.0 E+0	9.5 E+4
Cr-51	9.7 E+3	8.9 E-2	2.7 E-5	2.5 E+0
Mn-54	1.4 E+3	1.2 E-2	3.7 E-6	3.5 E-1
Co-57	3.4 E+1	3.1 E-4	9.3 E-8	8.8 E-3
Co-58	5.6 E+4	5.2 E-1	1.5 E-4	1.5 E+1
Fe-59	1.0 E+3	9.6 E-3	2.9 E-6	2.7 E-1
Co-60	3.9 E+3	3.5 E-2	1.1 E-5	1.0 E+0
Nb-95	9.9 E+2	9.1 E-3	2.7 E-6	2.6 E-1
Zr-95	4.3 E+2	4.0 E-3	1.2 E-6	1.1 E-1
Sn-117m	8.5 E+2	7.8 E-3	2.3 E-6	2.2 E-1
Sb-122	1.1 E+1	9.7 E-5	2.9 E-8	2.8 E-3
Sb-124	1.1 E+4	9.9 E-2	2.9 E-5	2.8 E+0
Sb-125	6.1 E+3	5.6 E-2	1.7 E-5	1.6 E+0
Te-125m	1.4 E+4	1.3 E-1	3.8 E-5	3.6 E+0
Sb-126	1.1 E+2	1.0 E-3	3.1 E-7	2.9 E-2
Cs-134	5.6 E+1	5.1 E-4	1.5 E-7	1.5 E-2
Cs-137	3.6 E+3	3.4 E-2	1.0 E-5	9.5 E-1

The 17 radionuclides in Table 5 were evaluated to determine which were potentially significant contributors to dose through the ingestion and external radiation exposure pathways. This screening allowed the calculations to be simplified by reducing the number of nuclides included in calculations. The level of significance was established at greater than 99 percent of the exposure pathway screening dose. The radionuclides with the highest doses would be included until greater than 99 percent of the total pathway dose was reached. At this point, radionuclides contributing lower doses would not be considered. Each exposure pathway was evaluated separately using water screening factors from NCRP Report No. 123 (NCRP 1996).

Table 6 lists the results of the radionuclide screening for the ingestion and external dose exposure pathways. The screening eliminated 12 radionuclides from further consideration for each pathway, but retained radionuclides that contributed only 0.5 percent and 0.7 percent of the total dose for the ingestion and external dose pathways, respectively to reach the greater than 99 percent of total dose significance level. For the external exposure pathway, the radionuclides contributing greater than 99 percent of the dose were cobalt-60, cobalt-58, antimony-124, antimony-125, and cesium-137. For the ingestion exposure pathway, the radionuclides contributing greater than 99 percent of the dose were tritium, cobalt-60, cobalt-58, antimony-124, and cesium-137. The ingestion pathway screening included water and meat ingestion.

Table 6. Radionuclide screening for ingestion and external dose exposure pathways.

Ingestion Pathway			External Dose Pathway		
Radionuclide	**Fraction of Dose**	**Cumulative Percentage**	**Radionuclide**	**Fraction of Dose**	**Cumulative Percentage**
H-3	0.86	86.4%	Cs-137	0.79	78.9%
Cs-137	0.075	93.8%	Co-60	0.16	95.0%
Co-58	0.028	96.6%	Sb-125	0.023	97.3%
Co-60	0.023	98.8%	Co-58	0.013	98.6%
Sb-124	0.0053	99.4%	Sb-124	0.0071	99.3%
Not included in scenario dose calculations:					
Te-125m	0.0027	99.6%	Cs-134	0.0027	99.6%
Cs-134	0.0010	99.7%	Te-125m	0.0024	99.8%
Fe-59	0.0009	99.8%	Mn-54	0.0010	99.9%
Sb-125	0.0009	99.9%	Fe-59	0.0003	100.0%
Cr-51	0.0002	99.9%	Zr-95	0.0002	100.0%
Sn-117m	0.0002	100.0%	Nb-95	0.0001	100.0%
Mn-54	0.0002	100.0%	Sn-117m	0.0000	100.0%
Nb-95	0.0001	100.0%	Cr-51	0.0000	100.0%
Zr-95	0.0001	100.0%	Sb-126	0.0000	100.0%
Sb-126	0.0001	100.0%	Co-57	0.0000	100.0%
Co-57	0.0000	100.0%	Sb-122	0.0000	100.0%
Sb-122	0.0000	100.0%	H-3	0	

The tritium water concentration of the spill was estimated based on a median groundwater plume concentration of approximately 230,000 pCi (Table 1, well P-13). The tritium spill concentration was estimated based on radioactive decay correction of the February 2006 plume concentration to June of 1998. Although the spill was detected in January, and was only thought to have occurred for 30 d, June was chosen to ensure a conservative estimate by adding additional time for radioactive decay correction.

Decay Correction Equation

$$C_0 = \frac{C}{e^{-\lambda t}} \qquad \text{(Equation 7)}$$

where:

C_0 = concentration of tritium in original spill
C = median concentration of tritium in the plume (230,000 pCi/L)
λ = tritium decay constant of 5.634 E-2 based on a 12.3-year half-life
t = the time in years from the spill to the plume sample (7.68 yr)

The calculated spill concentration was 354,460 pCi/L; a value of 350,000 pCi/L was used for the calculation. The other significant ingestion nuclides were scaled to the 350,000-pCi/L tritium concentration using the hydrogen-3 scaling factors in Table 5. Table 7 lists the scaled, estimated radionuclide concentrations for the spill water. RG 1.109 does not provide factors for antimony, so lumped parameters from DOE (2002) were used. These parameters are concentrations ratios that allow concentrations in soil and water to be used to make estimates of concentrations in animal and plant mass.

Table 7. Calculated 1998 VB-3 spill area water and soil concentrations.

Nuclide	Pooled Water C_w pCi/L	Vault Area Soil Conc C_s pCi/kg	B_{iv} Veg/Soil	C_{iv} Vegetation pCi/kg	DOE-STD-1153 lumped parameter Soil	DOE-STD-1153 lumped parameter Water	F_f Meat d/kg	C_A Meat pCi/kg
H-3	3.5 E+5	–	–	3.5 E+5	–	–	1.2 E-2	1.0 E+4
Sb-124	1.0 E+1	5.8 E+2			4.3 E-4	5.2 E-3		3.0 E-1
Sb-125[1]	–	3.3 E+2	–	–	–	–	–	–
Co-58	5.4 E+1	3.0 E+3	9.4 E-3	2.8 E+1	–	–	1.3 E-2	1.1 E+0
Co-60	3.7 E+0	2.1 E+2	9.4 E-3	1.9 E+0	–	–	1.3 E-2	7.8 E-2
Cs-137	3.5 E+0	1.9 E+2	1.0 E-2	1.9 E+0	–	–	4.0 E-3	2.3 E-2

1. Sb-125 is only considered in the external dose pathway; other parameters listed are not needed.

As part of the 10 CFR 50.75(g) documentation for the VB-3 leak, soil samples were collected in 2001, in the immediate vicinity of the vault. Figure 5 shows the grid of 10- by 10-m soil-sampling locations around the vault with the cobalt-60 results. The soil samples from two grids immediately adjacent to the vault were the only ones with detectable concentrations of cobalt-60. Table 8 lists the sample data.

Although most positive cesium-137 results are probably due to environmental background from fallout, they were included to ensure a conservative dose calculation. MDAs reported for the gamma spectroscopy results also were used when samples results reported no detectable activity. This biased the overall results to higher concentrations, which resulted in more conservative estimates of dose. The average cobalt-60 concentration was 1.4 E-7 μCi/g. The average cesium-137 result was 1.8 E-7 μCi/g. The average soil concentrations in April 2001 were decay corrected using a 5.26-yr half-life for cobalt-60, a 30.2-yr half-life for cesium-137, a 2.9-yr decay time, and Equation 7. These decay-corrected average results reflect the soil contamination levels around the valve in 1998. When applied to the entire spill area, they conservatively estimate the soil contamination levels in which food eaten by white-tailed deer was grown.

The average cobalt-60 soil concentration and the scaling factors for cobalt-60 from Table 5 were used to calculate the soil concentration of radionuclides other than cesium-137 and hydrogen-3. The average value for cesium-137 was used as the soil concentration with no scaling. Tritium water concentrations were assumed to equal those in the vegetation consumed by the deer in accordance with Equation 3. Table 8 lists the calculated soil concentrations.

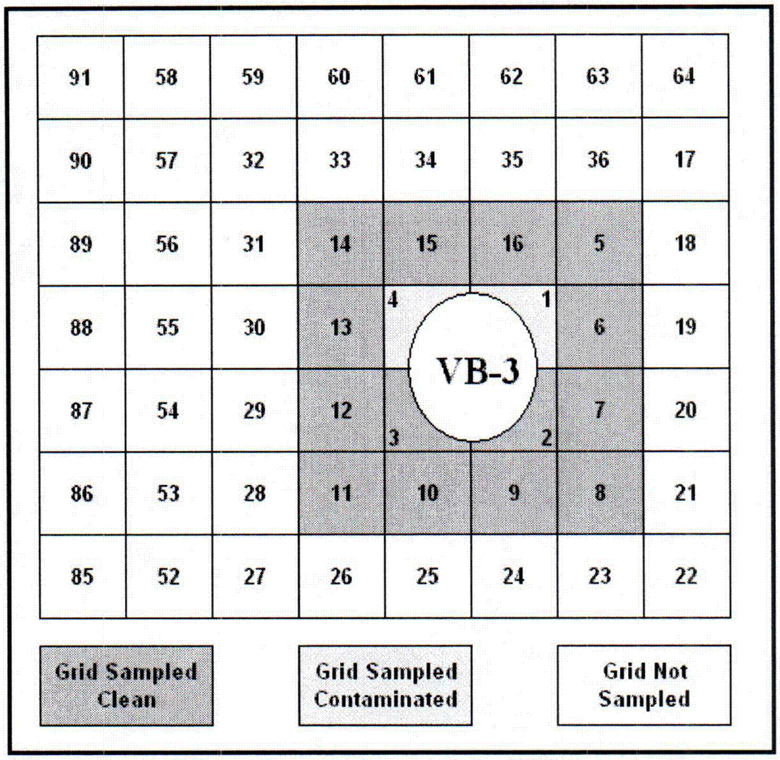

Figure 5. Soil sampling grid around the VB-3 vault.

Table 8. VB-3 spill area soil sample results (2001).[1, 2]

Grid No.	Co-60 Concentration µCi/g	Cs-137 Concentration µCi/g
1	2.5 E-7	8.6 E-8
2	ND (6.5 E-8)	ND (6.8 E-8)
3	ND (5.4 E-8)	2.1 E-7
4	1.0 E-6	3.0 E-7
5	ND (8.0 E-8)	1.3 E-7
6	ND (7.2 E-8)	1.4 E-7
7	ND (4.8 E-8)	1.9 E-7
8	ND (1.0 E-7)	5.8 E-7
9	ND (6.3 E-8)	ND (6.7 E-8)
10	ND (9.3 E-8)	1.3 E-7
11	ND (8.7 E-8)	2.4 E-7
12	ND (6.3 E-8)	1.6 E-7
13	ND (6.9 E-8)	1.7 E-7
14	ND (9.1 E-8)	1.8 E-7
15	ND (8.6 E-8)	1.3 E-7
16	ND (1.4 E-8)	ND (5.6 E-8)
Average[3]	1.4 E-7	1.8 E-7

1. ND = sample results reported as nondetectable and assumed to be at the minimum detectable concentration (MDC).
2. Sample date is April 26, 2001.
3. The average includes the nondetectable results at the MDC.

The calculated soil concentrations were used as the basis for calculating the radionuclide concentrations that could have been in spill area vegetation and consumed by game animals.

Calculating Radionuclide Concentrations in Vegetation from Soil Concentrations

$$C_{iv} = B_{iv} \; C_{si} \qquad \text{(Equation 8)}$$

where:

- C_{iv} = concentration of radionuclide i in the vegetation, pCi/kg
- B_{iv} = concentration ratio of vegetation to soil, unitless
- C_{si} = concentration of radionuclide i in the soil, pCi/kg

The concentration ratio (B_{iv}) is the concentration in vegetation (pCi/kg) per unit soil concentration (pCi/kg); values for this parameter were taken from Table E-1 of RG 1.109 (NRC 1977).

These spill water and soil concentrations were used to calculate the concentration in meat of game animals for each radionuclide (Equation A-14 from RG 1.109).

Calculating Radionuclide Concentrations in Meat

$$C_{Ai} = F_{Ai} \left(C_{wi} \, Q_{Aw} + C_{fi} \, Q_{Af} \right) \qquad \text{(Equation 9)}$$

where, for radionuclide i:

- C_{Ai} = radionuclide concentration in meat of the animal, pCi/kg
- F_{Ai} = stable element transfer factor for meat, d/kg (Table E-1, RG 1.109)
- C_{wi} = radionuclide concentration in the water the animal drinks, pCi/L
- Q_{Aw} = the quantity of water the animal drinks daily, L/d
- C_{fi} = radionuclide concentration in feed (f) the animal eats, pCi/kg
- Q_{Af} = quantity of animal feed consumed daily, kg/d

3.6 Calculating External Radiation Doses

Dose from exposure to direct radiation from radionuclides deposited in the soil was calculated in accordance with RG 1.109, Equation A-6, without correction for radioactive decay (NRC 1977). No correction for radioactive decay is a simplification that is conservative for shorter-lived radionuclides but has little effect for longer-lived radionuclides over a 1-yr exposure period.

$$R_i = S_i \, U \, D_i \, W \qquad \text{(Equation 10)}$$

where, for radionuclide i:

- S_i = radionuclide area concentration in soil, pCi/m^2
- D_i = dose factor, mrem per hr/pCi per m^2
- R_i = annual dose, mrem/yr

U = exposure time, hr/yr
W = geometry factor, unitless (Table A-2, RG 1.109)

Because most of the spill area is inside the fenced Exelon property, the only publicly accessible portion of the spill area is in the ditch adjacent to Smiley Road. The hypothetical soil concentrations in the ditch in 1998 following the VB-3 release were calculated based on ratios determined from VB-2 spill information. For the VB-2 spill in 2000, the ratio of the tritium concentration in water samples from the ditch (35,000 pCi/L) to the composite tritium level in the blowdown line at the time (91,400 pCi/L, see Section 2.3) was 0.38. The spill area concentrations determined near the VB-3 vault in Table 7 (original spill concentration) were multiplied by this ratio to estimate the potential soil concentrations in the ditch. Table 9 lists the calculated hypothetical soil concentrations in the ditch. The ditch soil concentration was used to calculate the estimated area concentration (pCi/m^2) by assuming the activity was distributed in the soil surface to a depth of 5 cm and using a soil density of 1.3 g/cm^3, as shown in Equation 11:

$$S_i = C_{si} \times 10{,}000\, cm^2/m^2 \times 5 cm\ deep \times 1.3 g/cm^3 \times 0.001 kg/g$$
$$= C_{si} \times 65\, kg/m^2 \qquad \text{(Equation 11)}$$

where, for radionuclide i:

S_i = radionuclide area soil concentration, pCi/m^2
C_{si} = radionuclide mass concentration in soil, pCi/kg

Table 9. External radiation dose calculation data.

Nuclide	VB-3 Vault Area Soil Concentration pCi/kg	Derived Ditch Soil Concentration pCi/kg	Derived Ditch Area Concentration pCi/m^2	Dose Factor mrem/hr per pCi/m^2
Sb-124	5.8 E+2	2.2 E+2	1.4 E+4	2.3 E-8
Sb-125	3.3 E+2	1.3 E+2	8.1 E+3	5.7 E-9
Co-58	3.0 E+3	1.2 E+3	7.5 E+4	7.0 E-9
Co-60	2.1 E+2	7.9 E+1	5.1 E+3	1.7 E-8
Cs-137	1.9 E+2	7.2 E+1	4.7 E+3	4.2 E-9

The external dose factors were from RG 1.109, Table E-6, except for the antimony isotopes that are not included in RG 1.109. Federal Guidance Report No. 12 (EPA 1993) was the source of external dose factors for antimony-124 and antimony-125.

4. BOUNDING ESTIMATES OF DOSE

This section presents bounding estimates of the radiation dose that members of the public could have received from exposure to tritium. The bounding estimates are the highest reasonable radiation doses that could have been received by members of public. The exposure scenarios developed for and described in this section could have resulted in public dose, regardless or whether or not they actually occurred. This section also hypothesizes potential exposure to radionuclides other than tritium in a limited number of scenarios, even though none of these other radionuclides have been detected offsite.

The bounding exposure scenarios are characterized in three different ways:

Reconstructed exposure scenarios have been prepared for the 1998 release from VB-3. These scenarios reconstruct the conditions that could have existed at the time of these releases—especially considering potential exposure from water that flowed over the surface of the ground—to make bounding estimates of public exposure that could have occurred. These reconstructed scenarios do not represent present or future exposure potential.

Current exposure scenarios are based on environmental conditions and radionuclide concentrations that currently exist around the Braidwood Station. These scenarios represent the bounding estimates of dose that nearby residents could be receiving in the present from the water that has leaked from the blowdown line VBs.

Hypothetical future scenarios assume no remediation and have the same types of exposures as the current scenarios but assume that residents are exposed to higher concentrations of tritium in the groundwater plume. Because the tritium concentrations are higher, the hypothetical future scenarios are the highest dose estimates presented.

The following sections present exposure scenarios and estimates of dose from VB releases in chronological order. The first release occurred in 1996.

4.1 Tritium Doses from the VB-1 Release (1996)

No reconstructed tritium dose scenarios were developed for the VB-1 1996 release because all released water remained on the site and did not flow overland to the ditch (the paved road into the Site provides an effective barrier between the vault and the ditch), and because groundwater has only recently reached the vicinity of the drainage ditch. Groundwater can flow into the drainage ditch and the potential exists for it to flow off the site. For purposes of the scenario the groundwater is assumed to flow undiluted directly into the drainage ditch on a seasonal basis (i.e., spring) and be present long enough to fulfill the exposure assumptions in the scenarios below. The groundwater/ditch water tritium concentration is assumed to be undiluted by rainwater or runoff, with a concentration of 1,200 pCi/L, the current concentration of tritium in groundwater at the ditch.

Two scenarios were considered for the VB-1 releases, based on the potential for groundwater to enter the drainage ditch and flow off the site; these scenarios were evaluated for possible current and hypothetical future exposure scenarios. The current scenario assumes a water concentration of 1,200 pCi/L (the current groundwater concentration at the ditch), while the hypothetical future scenario assumes a water concentration of 20,000 pCi/L (the concentration at the plume centerline that could reach the ditch sometime in the future with no remediation and be transported off the site).

4.1.1 Wading in the Drainage Ditch

The first scenario assumed children or teenagers play and wade in the water and inadvertently ingest some of the water containing tritium. A child or teenager was assumed to play in the ditch when water was present for 90 d and ingest 250 mL (8.5 oz) each time for a total of 22.5 L (23.8 quarts). There is minimal potential for dose from wading in the water and absorbing tritium through the skin. NUREG/CR-4013 considers absorption to be 0 (Strenge et. al 1985). The assumptions made for ingestion of the ditch water are considered to include any potential dose from absorption through the skin from wading in the water.

Table 10 lists the tritium dose for the ditch-wading/inadvertent water ingestion exposure scenario. The dose to a child from tritium under the current scenario with water concentration of 1,200 pCi/L would be about 0.004 mrem. Under the hypothetical future scenario with water concentration of 20,000 pCi/L the highest estimated tritium dose would be about 0.06 mrem to a child. This exposure and dose received is assumed to take place in 1 yr.

Table 10. Dose from ditch wading/inadvertent water ingestion scenario, VB-1 (mrem).

	Current Scenario	**Hypothetical/Future Scenario**
Water Concentration:	**1,200 pCi/L**	**20,000 pCi/L**
Age Group[1]		
Adult	N/A	N/A
Teenager	2.0 E-3	3.3 E-2
Child	3.8 E-3	6.4 E-2
Infant	N/A	N/A

1. Adults and infants would not be exposed during this scenario.

The estimated lifetime dose from this scenario would depend on how many years a child or teenager played in the ditch. An estimate of continuing exposure for 10 yr for the hypothetical future groundwater concentrations would result in a dose of about 0.5 mrem.

4.1.2 Consuming Wild Game Animals That Drink Ditch Water

Standing water in the drainage ditch could be consumed by wild game. This scenario evaluated the dose to a nearby resident that consumed wild game (deer and geese) that drink only the tritium-containing water standing in the drainage ditch. The evaluation assumed a 90-kg (200-lb) deer drinking 5.7 L/d and 5-kg (11-lb) geese drinking 0.42 L/d from the ditch for a period of time sufficient for the tritium concentration in meat to reach equilibrium with the tritium concentration in the ditch water (normally at least 30 d). An adult resident consumes all of the venison from the deer (30 kg), a teenager consumes about 18 kg, and a child consumes about 11 kg, while an infant would not consume venison. To provide a direct comparison of dose from consumption of the two types of wild game, the consumption rate of goose meat was assumed to be the same as the consumption rate of venison.

Table 11 lists the tritium dose from consuming the venison from ditch water exposure scenario. The concentration of tritium in venison is about 14 times higher than the concentration in goose meat, and the dose from venison would be 14 times higher than the dose from goose. The highest dose would be to an adult who ingested the venison; doses to teenagers and children would be lower. Adults receive higher doses because of the higher venison consumption rate. Under the current scenario the estimated dose from tritium would be less than 0.0003 mrem. Under the hypothetical future scenario the adult would also receive the highest dose, with about 0.004 mrem.

Table 11. Dose from ingesting venison and goose from ditch water scenario, VB-1 (mrem).

	Current Scenario	Hypothetical/Future Scenario
Water Concentration:	**1,200 pCi/L**	**20,000 pCi/L**
Age Group[1]	Venison (goose)	Venison (goose)
Adult	2.6 E-4 (1.9 E-5)	4.3 E-3 (3.1 E-4)
Teenager	1.5 E-4 (1.1 E-5)	2.6 E-3 (1.9 E-4)
Child	1.9 E-4 (1.4 E-5)	3.1 E-3 (2.2 E-4)
Infant	N/A	N/A

1. Infants would not be exposed during this scenario, because there are no usage factors for infants.

A lifetime dose of about 0.07 mrem from the hypothetical future scenario was estimated, based on an adult consuming 30 kg of venison every year for 70 yr.

4.2 Doses from the VB-3 Release (1998)

The November 1998 release fromVB-3 could have resulted in potential exposures from both groundwater and surface water because it was a large leak. It was estimated to be 3 million gal (see Table 2) that flowed out of the vault and over the ground surface, pooling in low-lying areas and the Smiley Road ditch before eventually soaking into the soil and reaching the groundwater. Water in the radioactive waste tanks that were released to the blowdown line (see Section 2) contained trace concentrations of radionuclides other than tritium. There is no indication that any of these other radionuclides ever reached the offsite environment. Information compiled for the 10 CFR 50.75(g) documentation files in 2001 show that cobalt-60 was detected in a few soil samples in the immediate area of the VB-3 vault where the leak originated; no other radionuclides were detected. To provide bounding estimates of the exposure and dose that could have been received, these other radionuclides are assumed to have been present in the water that flowed overland. Section 3.5 presents the method used to identify other radionuclides and their potential concentrations that could have been present in the offsite environment.

The following sections present a number of different types of exposure scenarios. They include reconstructed exposure scenarios that could have resulted in exposures to nearby residents around the time of the release in 1998, as well as current and hypothetical future exposure scenarios that could result from the presence of tritium in groundwater and in the water of the Exelon Pond.

4.2.1 External Exposure from Radionuclides Deposited in Smiley Road Ditch

The other radionuclides detected in water samples from the radioactive waste tank that was released to the blowdown line were assumed to have been in the water released from the VB-3 vault (see Section 3.5) that accumulated in the Smiley Road ditch. The other radionuclides (tritium is not a contributor to external dose) were assumed to have been deposited on the soil surface as the water drained. These beta/gamma radiation-emitting radionuclides were assumed to deliver an external dose to a person walking nearby on Smiley Road. This person was assumed to routinely pass the ditch for 1 hour/d for 1 yr; radioactive decay of the radionuclides and shielding from leaching into deeper layers of the soil were not considered. The geometry of the ditch was assumed to be similar to the geometry of a river bank and a geometry factor of 0.2 (W) was applied to account for the difference in dose compared to standing in the middle of an infinite plane source ($W = 1.0$) using the factor from RG 1.109.

Table 12 lists the dose to a routine passerby from beta/gamma-emitting radionuclides present in the Smiley Road ditch. There would be no difference in external dose to the adult, teenager, child, or infant. The dose to this hypothetical individual under the reconstructed exposure scenario would be about 0.001 mrem. This exposure and dose is assumed to take place over the course of 1 yr.

Table 12. External dose from radionuclides in the Smiley Road Ditch scenario, VB-3 (mrem).

	Reconstructed Scenario					
Age Group[1]	Co-58	Sb-124	Co-60	Sb-125	Cs-137	Total
Adult Teenager Child Infant	5.9 E-4	3.7 E-4	9.8 E-5	5.2 E-5	2.2 E-5	1.1 E-3

1. Infants would likely not be exposed during this scenario, except as infant in arms.

The radionuclides in the ditch soil would continue to decay radioactively after being deposited. They could also leach through the soil or become covered by additional soil layers, further reducing the dose rate at the road. After a period of about 2 yr, the samples in 2001 showed only cobalt-60 to be present above minimum detectable activities. Therefore, radionuclides were assumed to decrease to the levels measured in 2001. A conservative estimate of the lifetime dose from external exposure would be 2 times the value presented above because short-lived radionuclides (cobalt-58, antimony-124) would have decayed away, and there is no indication of longer-lived radionuclides (antimony-125, cesium-137) that should have been detected if present.

4.2.2 Consuming Wild Game That Drinks Pooled Surface Water

As described in the earlier sections, leakage from the VB-3 vault flowed across the ground surface and pooled in low-lying areas and filled the ditch on the south side of Smiley Road. The concentration of this water was not sampled during the release in 1998. Therefore, tritium concentrations in pooled surface water were estimated by using the median concentration detected in groundwater near the location (230,000 pCi/L) and accounting for radioactive decay since the time of the release. The assumed initial concentration in the pooled surface water from the VB-3 release was 350,000 pCi/L.

This scenario was evaluated to reconstruct any potential dose from the 1998 release. There are no current or hypothetical future exposure scenarios because the pooled and standing ditch water from the line existed only at the time of release. It was assumed a 90-kg (200-lb) deer drank the water and the venison was subsequently consumed by a nearby resident. The deer drank 5.7 L/d for a period of time sufficient for the tritium concentration in deer meat to reach equilibrium with the tritium concentration in the ditch water (normally at least 30 d). Only a portion of the deer's drinking water (12 percent) was from the pooled water or Smiley Road ditch because the deer's normal range would provide it the opportunity to drink from numerous other sources of surface water in the area (see carrying capacity basis presented in Section 4.2.3). An adult resident was assumed to consume all of the venison from the deer (30 kg), a teenager to consume about 18 kg, and a child to consume about 11 kg. The potential dose from consumption of wild geese was also considered; however, Section 4.1.2 (Table 11) demonstrated that consumption of goose results in a dose that is about 7 percent of that from consuming venison, so no further evaluation was done.

Table 13 lists the tritium dose from consuming the venison from the ditch water exposure scenario. The highest dose would be to an adult who ingested the venison; doses to teenagers and children would be lower. Adults receive higher doses because of the higher venison consumption rate. Under the reconstructed exposure scenario the estimated adult dose from tritium would be about 0.01 mrem.

Table 13. Dose from eating deer that drinks ditch water scenario, VB-3 (mrem).

	Reconstructed Scenario
Water Concentration:	**350,000 pCi/L**
Age Group[1]	
Adult	9.5 E-3
Teenager	5.4 E-3
Child	6.5 E-3
Infant	N/A

1. Infants would not be exposed during this scenario, because there are no usage factors for infants.

The estimated lifetime dose from this scenario would be the same as shown in Table 13. No continuing dose from this scenario would occur because the water drained from the ditch.

4.2.3 Consuming Wild Game Ingesting Water and Vegetation from the Surface Spill Area

This scenario is similar to that in Section 4.2.2, but it also includes game animal consumption of vegetation growing in the area where the surface flow from the VB-3 vault occurred. The tritium concentration of the water flowing over the surface was assumed to the same as that detected at the centerline of the tritium groundwater plume, corrected for radioactive decay since the release occurred in 1998. The concentration used in calculations was 350,000 pCi/L. Other radionuclides also could have been deposited in these areas when the water drained into the soil. The standing water could have been drunk by game and later the following spring vegetation growing in these areas could have absorbed the deposited radionuclides and then be consumed by game animals. The area of the water flow across the surface and standing water were estimated to cover an area of about 15,000 m^2 between VB-3 vault and the Exelon Pond. This is a triangular area that roughly approximates the current area of the groundwater tritium plume.

Deer have been shown to be the wild game animal with the greatest potential for dose to humans through consumption of venison. A 90-kg (200-lb) deer was assumed to drink 5.7 L/d of water and consume 15 kg/d of vegetation. The deer was assumed to consume a portion of its water and feed from the area where the standing water and overland transport of water took place. This consumption was assumed to take place for a period of time sufficient for the radionuclide concentrations in deer meat to reach equilibrium with the radionuclides in water and vegetation. Murphy (1970) cites research by Hosley (1956) as to the relatively consistent carrying capacity of white-tailed deer in the Midwest of 1 deer per 32 acres (13 hectares). Based on this carrying capacity the presumed surface area of the overland release would comprise about 12 percent of the range of a deer. Therefore, a deer around the Braidwood Station was assumed to get 12 percent of its food and water from the area of the spill. This is a conservative assumption that results in an overestimation of dose because the standing water was present for no more than 30 d (shorter than the time required for equilibrium with tritium to be reached) and tritium is the main contributor to ingestion dose. Also, radionuclides are assumed to be deposited evenly over the entire area of the spill, when it is more likely that surface flow and any radionuclide deposition occurred only in the low-lying area, reducing the percentage of potentially contaminated vegetation consumed.

As in the game consumption scenarios discussed above, an adult resident was assumed to consume all of the venison from the deer (30 kg), a teenager to consume about 18 kg, and a child to consume about 11 kg.

Table 14 lists the dose to nearby residents from consuming the venison obtained from a deer drinking this water and consuming the vegetation. The dose to the highest exposed organ is also presented in this table because ingestion of radionuclides other than tritium differentially affect different organs, while dose from tritium is the same for all organs and presented as a total body dose. Tritium is by far the dominant dose contributor from this pathway, contributing greater than 99 percent of the dose. The dose is highest to an adult because of consumption rates of venison and water. The total body dose is about 0.03 mrem and the dose to the maximally exposed organ, the gastrointestinal tract/lower large intestine (GI-LLI) is also about 0.03 mrem.

The radionuclides in the soil and vegetation would continue to decay radioactively and to become less available as they moved deeper into the soil. They could also migrate through the soil (especially tritium) and become less available for uptake by plants. After a period of about 2 yr the samples in 2001 showed only cobalt-60 to be present above its MDA. Lifetime total body doses would be less than double those presented above, mainly due to tritium becoming less available in water and surface soil. The lifetime dose would be about 0.05 mrem.

4.2.4 Drinking Well Water

The leakage from VB-3 resulted in a plume of groundwater containing tritium. This plume has extended north from VB-3, underneath and through the Exelon Pond, and into a private well north of the pond. This scenario assumed the well was used for drinking water consumed by onsite residents. The identified tritium concentration in this water well at the present time for the

Table 14. Dose from ingesting venison from overland release scenario, VB-3 (mrem).

Water Concentration:	Reconstructed Scenario 350,000 pCi/L	
Age Group[1]	Total body[2]	Organ[2] – GI-LLI
Adult	3.3 E-2	3.4 E-2
Teenager	2.0 E-2	2.0 E-2
Child	2.4 E-2	2.4 E-2
Infant	N/A	N/A

1. Infants would not be exposed during this scenario, because there are no usage factors for infants.
2. Contributing radionuclides include cobalt-60, cobalt-58, antimony-125, and cesium-137 as well as tritium (H-3).

current scenario is approximately 1,500 pCi/L. This is a conservative concentration for the current scenario because the concentration has been increasing as the plume moves north toward the well; at previous times the well concentration would have been lower, resulting in less dose. For the hypothetical future scenario, the well water concentration is assumed to increase to 3,000 pCi/L. For both current and future scenarios, an adult resident drinks 730 L/yr from the well, a teenager and child each drink 510 L/y, and an infant drinks 330 L/yr (values from RG 1.109).

Table 15 lists the tritium dose from using well water as a source of all drinking water. The highest annual dose would be to a child, with slightly lower dose to an infant. Under the current scenario based on 1,500 pCi/L the estimated dose to a child from tritium would be about 0.15 mrem. Under the hypothetical future scenario the dose to the child would be about 0.3 mrem.

Table 15. Dose from ingesting well water scenario, VB-3 (mrem).

Water Concentration:	Current Scenario 1,500 pCi/L	Hypothetical/Future Scenario 3,000 pCi/L
Age Group		
Adult	1.2 E-1	2.3 E-1
Teenager	8.2 E-2	1.6 E-1
Child	1.6 E-1	3.1 E-1
Infant	1.5 E-1	3.0 E-1

A lifetime dose of about 4 mrem from the hypothetical future scenario was estimated, based on 70 yr of an adult consuming 730 L of well water every year.

4.2.5 Consuming Irrigated Garden Produce

This scenario uses the information and groundwater concentrations from the private well drinking water scenario and assumes this water is used to fully irrigate a backyard produce garden that is consumed by a local resident. This is an unlikely scenario and was specifically excluded from the Braidwood Offsite Dose Calculation Manual, but is included so a complete set of potential exposure scenarios is evaluated. As noted above for the well drinking water scenario, the water concentration is approximately 1,500 pCi/L for the current scenario and 3,000 pCi/L for the hypothetical future scenario. An adult resident consumes 520 kg/yr from the garden, a teenager 630 kg/yr, and a child 520 kg/yr. An infant consumes no produce from the garden.

Table 16 lists the tritium dose from using well water as a source of irrigation for a backyard garden. The highest annual dose would be to a child. Under the current scenario based on 1,500 pCi/L the estimated dose to a child from tritium would be less than 0.2 mrem. Under the hypothetical future scenario based on 3,000 pCi/L, the annual dose to the child would be slightly more than 0.3 mrem.

Table 16. Dose from consuming garden produce scenario, VB-3 (mrem).

	Current Scenario	Hypothetical/Future Scenario
Water Concentration:	1,500 pCi/L	3,000 pCi/L
Age Group[1]		
Adult	8.3 E-2	1.6 E-1
Teenager	1.0 E-1	2.0 E-1
Child	1.6 E-1	3.2 E-1
Infant	N/A	N/A

1. Infants would not be exposed during this scenario, because there are no usage factors for infants.

A lifetime dose of less than 3 mrem from the hypothetical future scenario was estimated, based on 70 yr of an adult consuming 520 kg/yr of garden produce irrigated with the well water.

4.2.6 Consuming Fish from the Exelon Pond

The tritium groundwater plume resulting from the VB-3 release has migrated into the Exelon Pond. This scenario evaluates potential doses that could be received from ingesting fish caught in the pond. The current tritium concentration of water in the Exelon Pond is approximately 3,000 pCi/L. This is a conservative concentration for the current scenario because the concentration has been increasing as the plume moves north toward the pond; for any earlier exposures the pond concentration would have been lower, resulting in less dose. For the hypothetical future scenario the pond tritium concentration was assumed to increase to 6,000 pCi/L. An adult resident consumes 21 kg/yr of fish from the pond, a teenager 16 kg/y, and a child 6.9 kg/y. An infant consumes no fish from the pond.

Table 17 lists the tritium dose from consuming fish from the Exelon Pond. The highest dose would be to an adult because of the higher fish consumption rates. Under the current scenario based on 3,000 pCi/L, the estimated annual dose to an adult would be 0.006 mrem. Under the hypothetical future scenario based on 6,000 pCi/L, the annual dose to the adult would be slightly more than 0.01 mrem.

Table 17. Dose from consuming fish from the Exelon Pond scenario, VB-3 (mrem).

	Current Scenario	Hypothetical/Future Scenario
Water Concentration:	3,000 pCi/L	6,000 pCi/L
Age Group[1]		
Adult	6.0 E-3	1.2 E-2
Teenager	4.6 E-3	9.2 E-3
Child	3.8 E-3	7.6 E-3
Infant	N/A	N/A

1. Infants would not be exposed during this scenario, because there are no usage factors for infants.

A lifetime dose of about 0.2 mrem from the hypothetical future scenario was estimated, based on 70 yr of an adult consuming 21 kg/yr of fish from the Exelon Pond.

4.2.7 Consuming Wild Game That Use Exelon Pond

This scenario evaluates potential doses from consuming wild game – deer and geese – that use the Exelon Pond as a sole source of drinking water. A 90-kg (200-lb) deer is assumed to drink 5.7 L/d from the pond. Five-kg (11 lb) geese are assumed to consume 0.42 L/d of pond water. An adult resident consumes all of the venison from the deer (30 kg), a teenager consumes about 18 kg, and a child consumes about 11 kg. For a consistent comparison, the same quantities of goose meat (30 kg, 18 kg, 11 kg) were assumed to be consumed. As discussed under the fish consumption scenario above, the current scenario tritium concentration in the pond is 3,000 pCi/L and the hypothetical future scenario concentration is assumed to be 6,000 pCi/L.

Table 18 lists the tritium dose from consuming the venison from deer that use the Exelon Pond for drinking water. The potential dose from consumption of wild geese was also considered; however, Section 4.1.2 (Table 11) demonstrated that consumption of goose results in a dose that is about 7 percent of that from consuming venison, so no further evaluation was done.

Table 18. Dose from consuming deer that use the Exelon Pond scenario, VB-3 (mrem).

	Current Scenario	Hypothetical/Future Scenario
Water Concentration:	**3,000 pCi/L**	**6,000 pCi/L**
Age Group[1]		
Adult	6.5 E-4	1.3 E-3
Teenager	3.9 E-4	7.7 E-4
Child	4.7 E-4	9.3 E-4
Infant	N/A	N/A

1. Infants would not be exposed during this scenario, because there are no usage factors for infants.

The highest dose would be to an adult who ingested the venison; doses to teenagers and children would be lower. Adults receive higher doses because of the higher venison consumption rate. Under the current scenario the estimated dose to an adult from tritium would be less than 0.0007 mrem. Under the hypothetical future scenario the estimated dose to adult would be about 0.001 mrem.

A lifetime dose of 0.02 mrem from the hypothetical future scenario was estimated, based on 70 yr of an adult consuming 30 kg/yr of venison from deer drinking from the Exelon Pond.

4.2.8 Swimming in the Exelon Pond

Children or teenagers could swim in the Exelon Pond and inadvertently ingest some of the water containing tritium. A child or teenager was assumed to swim for 90 d over the course of a summer, and ingest 250 mL (8.5 oz) each time, ingesting a total of 22.5 L (23.8 quarts). There is minimal potential for dose from absorbing tritium through the skin; the NUREG/CR 4013 (Strenge et. al 1985) dose factor for absorption through the skin in water is 0.

Table 19 lists the tritium dose from swimming in the Exelon Pond. The dose to a child from tritium under the current scenario with a pond water concentration of 3,000 pCi/L would be less than 0.01 mrem. Under the hypothetical future scenario, with a water concentration of 6,000 pCi/L, the highest estimated tritium dose would be about 0.02 mrem to a child. The dose to a teenager would be less.

Table 19. Dose from swimming in the Exelon Pond scenario, VB-3 (mrem).

	Current Scenario	Hypothetical/Future Scenario
Water Concentration:	3,000 pCi/L	6,000 pCi/L
Age Group[1]		
Adult	N/A	N/A
Teenager	5.0 E-3	1.0 E-2
Child	9.6 E-3	1.9 E-2
Infant	N/A	N/A

1. *Adults and infants would not be exposed during this scenario.*

The estimated lifetime dose from the hypothetical future scenario would depend upon how many years a child or teenager swam in the pond. An estimate of continuing exposure for 10 yr would result in a dose of less than 0.2 mrem.

4.2.9 Exposure to Center Street Ditch Water

Recent samples of water collected from the Center Street ditch (see Figure 1) were found to contain tritium concentrations less than 1,000 pCi/L. This tritium likely originated from the shallow groundwater plume underlying the area (see Figure 3) and reached the ditch through drainage tiles in nearby fields during the winter and early spring when the groundwater table rises. Potential exposure scenarios for this water have been previously evaluated at higher tritium concentrations in the site drainage ditch in Section 4.1.1 (ditch wading), the Smiley Road ditch in Sections 4.1.2 and 4.2.2 (consuming animals that drink the water), and possibly the VB-3 spill area in Section 4.2.3 (consuming animals that drink the water and eat vegetation growing there). Because these other scenarios bound potential doses that could be received from exposure to tritium in the Center Street ditch water, no estimates of dose are provided here.

4.3 Dose from the VB-2 Release (2000)

The 2000 release fromVB-2 was similar in volume to the earlier 1998 release from VB-2, but concentrations of radionuclides were less than those in the VB-3 release (see Section 2.3). In addition, standing water from the VB-2 release was removed from the ground surface by pumping it back into the blowdown line. This resulted in a significantly smaller groundwater plume and lower tritium concentrations in the plume than for releases from VB-3. Groundwater monitoring determined that the VB-2 groundwater plume has not moved off the site (Figures 3 and 4); therefore, none of the offsite groundwater exposure scenarios apply for VB-2.

The information presented in Section 2.3 indicates the average tritium concentration in water at the time of the VB-2 release was about 27 percent of that during the VB-3 release. There was surface flow of water from the VB-2 vault and pooling on the surface of the ground and collecting in the Smiley Road ditch. Therefore, exposure scenarios that apply to VB-2 include:

- Consuming wild game that use ditch water, Section 4.2.1 (tritium)
- External exposure from radionuclides deposited in ditch, Section 4.3.1 (other radionuclides)
- Consuming wild game that ingests water and vegetation, Section 4.3.2 (tritium, other radionuclides)

The doses from the VB-2 release are estimated to be about 27 percent of the VB-3 doses calculated in Section 4.2, because the VB-2 tritium release concentration was estimated to be 27 percent of the VB-3 tritium release concentration. Therefore, the doses calculated for the VB-3 release bound the VB-2 doses in cases applicable to both of these onsite VBs and no additional calculations are performed for the VB-2 release.

4.4 Tritium Dose from the VB-4 Release (2003)

VB-4 is located off the site between the Braidwood Station and the termination of the blowdown line at the Kankakee River. A small, low-flow leak occurred at VB-4 in 2003. No liquids reached the surface of the ground, and the tritium groundwater plume remains small. The highest concentration of tritium detected in the plume is approximately 32,000 pCi/L (Table 1). Although the VB location is off the site, there is little opportunity for exposure to this plume. Vegetation could have roots that reach the upper groundwater plume and absorb tritium into vegetation consumed by wildlife such as deer. Using the guidance of RG 1.109, the concentration of tritium in this vegetation is conservatively assumed to be the same as the groundwater concentration. No other radionuclides would be a source of exposure, and there are no other exposure pathways or scenarios.

Table 20 lists the dose from a hypothetical scenario of ingesting venison from deer that consumed vegetation with tritium from the VB-4 groundwater plume. The highest dose would be to an adult who ingested the venison, because of the higher venison consumption rate. Doses to teenagers and children would be lower. Under the current and hypothetical future scenarios the estimated dose from tritium would less than 0.02 mrem.

Table 20. Dose from ingesting venison consuming tritiated vegetation scenario, VB-4 (mrem).

	Current and Hypothetical/ Future Scenarios
Water Concentration:	**32,000 pCi/L**
Age Group[1]	
Adult	1.8 E-2
Teenager	1.1 E-2
Child	1.3 E-2
Infant	N/A

1. Infants would not be exposed during this scenario, because there are no usage factors for infants.

The estimated lifetime dose from this scenario, although unlikely, is based on 70 yr of an adult consuming 30 kg/yr of venison from deer consuming vegetation in equilibrium with tritium in the VB-4 groundwater plume. Assuming the tritium groundwater concentration would remain at 32,000 pCi/L, the lifetime dose would be about 1.3 mrem.

4.5 Tritium Dose from VB-6 and VB-7 Releases (dates undetermined)

VB-6 and VB-7 are also located off the site between the Braidwood Station and the termination of the blowdown line at the Kankakee River. Small, low flow leaks have occurred at these VBs in the past; low concentrations of tritium in groundwater were discovered in 2006 (see Table 1). No liquids reached the surface of the ground, and the tritium groundwater plume remains small. The highest concentration of tritium detected around both VB vaults is less than 3,000 pCi/L. Although the VB locations are offsite, there is little opportunity for exposure to this plume. The VBs are located in areas where crops (corn or sorghum stubble was observed) can be grown to feed livestock. The area of the plume under the cropland is small, and tritium would reach only a small portion of the crop if roots reached the upper groundwater plume and absorbed tritium. Other vegetation outside the cropland could absorb the tritium and be consumed by deer as described in Section 4.4. The tritium dose from consumption of livestock or deer by nearby residents is expected to be bounded by the dose estimates for releases from VB-4 presented in Section 4.4.

4.6 Summary of Bounding Exposure Scenario Dose Estimates

Table 21 summarizes the bounding exposure scenario dose estimates. The bounding potential dose to a member of the public from a bounding exposure scenario was estimated to be about 0.16 mrem/yr, from a child drinking water from a groundwater well north of the Exelon Pond. The exposure scenario of a child consuming a large amount of home-grown garden produce that was irrigated with the same well water resulted in about the same dose.

Table 21. Summary of bounding exposure scenarios and maximum doses (mrem/yr).

VB, year of release	Exposure Scenario	Age Group[1]	Dose	Hypothetical Future Dose
VB-1, 1996	Ditch wading/swimming	Child	0.0038	0.02
	Eating game that drinks ditch water	Adult	0.00026	0.004
VB-3, 1998	External exposure from ditch (R)[2]	All ages	0.0011	N/A[3]
	Eating game that drinks ditch water (R)[2]	Adult	0.0095	N/A[3]
	Eating game consuming vegetation & water from overland release (R)[2]	Adult	0.033	N/A[3]
	Drinking well water	Child	0.16	0.3
	Eating irrigated garden produce	Child	0.16	0.3
	Exelon Pond: eating fish	Adult	0.0060	0.01
	Exelon Pond: eating game that drink from the pond	Adult	0.00065	0.001
	Exelon Pond: swimming	Child	0.0096	0.02
VB-2, 2000	Less than applicable VB-3 scenarios	–	–	–
VB-4, 2003	Eating game consuming vegetation	Adult	0.018	0.018
VB-6, VB-7[4]	Less than VB-4 scenario	–	–	–

1. The age group (adult, teenager, child, or infant) with the highest dose for each scenario.
2. (R) indicates a reconstructed exposure scenario.
3. N/A = not applicable for this exposure scenario.
4. Exact release date undetermined, but maximum plume concentration determined.

The hypothetical future doses from continuing exposure to increased concentrations of tritium in groundwater are also presented. The same two exposure scenarios as above would result in the maximum doses of about 0.3 mrem/yr.

5. REALISTIC ESTIMATES OF DOSE

Section 4 presented bounding estimates of dose that were the highest reasonable estimates of dose that could have been received by nearby residents from the inadvertent releases of water from the blowdown line. The reconstructed exposure scenarios could only have occurred immediately following the releases, while other exposure scenarios were examined to evaluate current or future radiation dose potential. This section evaluates the exposure scenarios developed in Section 4 to develop more realistic estimates of radiation dose that members of the public could receive and to identify and focus on scenarios with the highest potential dose. A graded approach to this evaluation ensured that the appropriate level of analysis was used. The process started with the broad-based, conservative assessment of exposure scenarios in Section 4. This section refines that assessment with a more realistic, sharply defined analysis. The graded approach for this evaluation included the following criteria:

1. Likely scenarios. The broad umbrella of bounding exposure scenarios in Section 4 were more closely evaluated, and unrealistic scenarios were eliminated from further consideration.

2. Very low dose. Exposure scenarios that could have occurred but would result in very low doses under bounding conditions were eliminated from further consideration.

3. Realism. After criteria 1 and 2 were applied, the remaining exposure scenarios were adjusted to evaluate the actual exposure that could have occurred using assumptions and parameter values that more closely reflect the actual environmental conditions, characteristics, and lifestyles of nearby residents, wherever additional information was available and could be justified.

The purpose of applying this graded approach was to identify exposure pathways to which nearby residents could have actually been exposed, and to make realistic estimates of the radiation doses received from these exposures. These dose estimates can then be compared to the applicable NRC limits for radiation dose to members of the public.

An initial step was to establish a threshold for very low dose, below which no further consideration of a particular exposure scenario would be needed. An annual dose of 0.001 mrem was selected as a threshold screening level. This dose was considered to provide an adequate margin of conservatism below which there would be negligible health or regulatory concerns. From a health perspective this screening level corresponds to an annual risk level of 5.75×10^{-10}/yr (<1 in 1,000,000,000) using the Federal Guidance Report No. 13 mortality risk coefficient (EPA 1999). From a regulatory perspective, this screening level is well below the ALARA-based design objective of 6 mrem/yr for a two-unit site in 10 CFR 50, Appendix I (see Section 2.5), and even further below the 100-mrem/yr regulatory dose limit for a member of the public provided in 10 CFR 20, Subpart D. This screening level of 0.001 mrem is also a small fraction of the doses to the maximally exposed individual presented in the Braidwood Station annual radiological environmental operating reports (Commonwealth Edison 1999, 2001; Exelon 2002, 2003, 2004, 2005). A bounding scenario could be immediately eliminated from further consideration if the annual dose was less than 0.001 mrem. If a realistic scenario was determined to result in a dose lower than 0.001 mrem, then that scenario also was no longer considered.

5.1 Evaluation of Exposure Scenarios

None of the VB-1, VB-4, VB-6, or VB-7 exposure scenarios were considered a realistic source of exposure. The drainage ditch associated with VB-1 flows only intermittently and then mainly with runoff from rainwater rather than only with groundwater inflow. It is approximately 1/3 of a mile from the leading edge of the groundwater plume to the edge of the site, so any flow beginning in the area of the groundwater plume would have significant additional dilution before flowing off the site. The scenario of deer drinking ditch water and a nearby resident consuming the venison was already less than 0.001 mrem. The certain dilution in water present in the ditch would reduce all potential VB-1 exposures below 0.001 mrem/yr.

The VB-4 exposure scenario assumed that all of the vegetation consumed by deer was in equilibrium with tritium in the groundwater plume and that the deer ate only this vegetation. In reality this is a small plume that could comprise only a small fraction of deer's browsing/grazing range. It is also very unlikely that all of the consumable vegetation above the plume is in equilibrium with the tritium in the plume. The actual dose from this scenario would be less than 0.001 mrem/yr, so it was not considered further.

Exposure scenarios for releases from VB-6 and VB-7 were determined to be very similar to scenarios for VB-4 releases. The VB-4 scenario would bound VB-6 and VB-7 doses because the VB-4 groundwater tritium concentration is approximately 10 times higher than that around VB-6 and VB-7. Therefore, the dose would be less than 0.001 mrem/yr for VB-6 and VB-7 scenarios, and they were not considered further.

The exposures scenarios for VB-2 releases were determined to be a subset of the scenarios evaluated for VB-3 releases. As such, the VB-3 doses would bound the VB-2 doses due to (1) the higher concentrations of tritium in the VB-3 water released and (2) the VB-2 release was remediated by pumping standing water back into the blowdown line. Therefore, the potential doses from VB-2 exposure scenarios were encompassed by the following evaluation of VB-3 scenarios. VB-2 exposure scenarios were not explicitly considered further.

Exposure scenarios for the VB-3 releases represented the largest and most diverse set of potential exposures from any VB release. The following scenarios were evaluated and eliminated from further consideration:

- The reconstructed VB-3 exposure scenarios were eliminated from further consideration because they could have occurred only soon after the release and would have been of short duration. Any dose received would have been less than 0.001 mrem.

- Irrigation of a backyard garden that provides all of the produce for a resident is not considered a realistic exposure scenario because there is little irrigation in this area due to the substantial rainfall. Fulltime irrigation would be required for vegetation to be in equilibrium concentration with tritium in groundwater. Further, there is no indication within the existing groundwater plume footprint of a sufficiently large garden that could produce a large quantity of produce for individual consumption. There is only one private well with identified tritium concentrations attributable to the VB releases. Therefore, the actual dose from this scenario would be less than 0.001 mrem.

- The Exelon Pond is not the type of pond that children or teenagers would routinely swim in for 90 d/yr. Further, the amount of pond water assumed to be ingested is quite conservative. The dose under the bounding scenario was estimated at approximately 0.01 mrem/yr. A more realistic exposure would be less than 0.001 mrem/yr.

- Game animals that drink from the Exelon Pond are unlikely to use this pond as the only source of drinking water due to the large amount of surface water available in the area. It is more likely that a deer would use this pond for only a fraction of its drinking water. The bounding case dose estimate for this pathway was already less than 0.001 mrem/yr.

The remaining VB-3 exposure scenarios that required additional evaluation for realistic exposure conditions and realistic estimates of radiation dose were:

- Drinking well water (Section 4.2.5)
- Consuming fish from the Exelon Pond (Section 4.2.6)

5.2 Realistic Estimates of Dose

More realistic exposure scenarios were evaluated using assumptions and parameter values that more closely reflect the actual environmental conditions, characteristics, and lifestyles of nearby residents.

Evaluation of realistic exposure scenarios included calculation of dose using the tritium dose factors from NUREG/CR-4013 (Strenge et al. 1985) that are the basis for current Braidwood ODCM ingestion dose factors instead of the more conservative RG 1.109 (NRC 1977) values. These dose factors reduced the dose to 57 percent of the dose calculated under the bounding scenario.

Only one private well north of the Exelon Pond has tritium attributed to the VB releases (private well #8 in Table 1). Indications are that two adult residents have used the well for some portion of their drinking water, but the actual consumption rate is unknown. As shown in Table 4, the RG 1.109 water consumption rate for a maximally exposed individual is 730 L/yr, while the consumption rate for an average individual is 370 L/yr. The range of reasonable doses is from near zero if bottled water were the primary source of drinking water to 0.068 mrem/yr for well water consumption characteristic of a maximally exposed individual. The dose from average consumption of groundwater for drinking would be 0.034 mrem/yr.

It is possible for fish to be caught and consumed from the Exelon Pond, or at least the scenario cannot be excluded with information currently available. As shown in Table 4, the RG 1.109 fresh fish consumption rate for a maximally exposed individual is 21 kg/yr, while the consumption rate for an average individual is 6.9 kg/yr. The range of reasonable doses is from zero if no fish were caught and consumed from the Exelon Pond to 0.0034 mrem/yr for fish consumption characteristic of a maximally exposed individual. The dose from average consumption of fish from the Exelon Pond would be 0.0011 mrem/yr.

The highest realistic scenario of drinking water from the groundwater well is a potential exposure pathway for two adults using the well noted above. Summing the two realistic exposure scenarios (drinking water and fish consumption), the maximum realistic dose that these two adults could receive would be less than 0.072 mrem/yr. The highest dose any other individual could realistically receive would be 0.0034 mrem/yr. Table 22 summarizes the realistic exposure scenarios and the range of doses that could be received by members of the public.

Table 22. Summary of realistic exposure scenarios and doses to the public (mrem/yr).

Exposure Scenario	Minimum	Average (expected)	Maximum
Drinking well water (2 adults)	~ 0	0.034[1]	0.068[2]
Eating fish from Exelon Pond (more individuals)	0	0.0011	0.0034
Maximum individual summed dose	~ 0	< 0.04	< 0.072

1. Based on average individual drinking water ingestion rate of 370 L/yr.
2. Based on maximum individual drinking water ingestion rate of 730 L/yr.

6. CONCLUSIONS

This report documents the assessment of bounding and realistic doses that could have resulted, or might in the future result, from inadvertent releases from VBs in the blowdown lines at the Braidwood Station. Sections 1 and 2 provide the background, and Section 3 describes the evolution of potential exposure scenarios. Section 4 uses conservative scenarios from that evaluation to develop dose estimates that are likely to be the upper bound of any actual doses that could have been or could be received by members of the public. Section 5 further evaluates these conservative scenarios to eliminate from consideration those scenarios that are not realistic, and it describes the graded approach used to further refine the scenarios to present realistic estimates of dose, in accordance with 10 CFR Part 20; 10 CFR Part 50, Appendix I; and Regulatory Guide 1.109 (NRC 1997).

Evaluation of potential exposures from the VB releases using conservative exposure scenarios showed all potential doses to be very low. None of the bounding scenarios resulted in a dose over 0.3 mrem/yr or 0.3 mrem per event in any of the reconstructed, current, or hypothetical future scenarios. These bounding dose estimates are a small percentage of the 6 mrem/yr design objective for the site presented in 10 CFR 50, Appendix I, and even further below the 100-mrem/yr regulatory limit in 10 CFR Part 20. The estimated maximum realistic dose was 0.068 mrem/yr from drinking water consumption from a private well north of Exelon Pond; the average or expected value would be 0.034 mrem/yr. The maximum dose from summing the dose received from the two realistic exposure scenarios would be 0.072 mrem/yr. The average or expected dose from all realistic pathways would be less than 0.04 mrem/yr. These doses could be received by two adults who may have used private well #8 for drinking water. The maximum realistic estimate is only 1.2 percent of the 6-mrem/yr design objective in 10 CFR Part 50, Appendix I, and 0.07 percent of the 10 CFR Part 20 limit. This dose is less than the dose to the critical receptor at Wilmington, Illinois, from routine blowdown line releases to the Kankakee River during 2004, which was 0.088 mrem/yr (Exelon Nuclear 2005). It is also less than doses to the critical receptor at Wilmington from 1998 to 2004.

The National Council on Radiation Protection and Measurements (NCRP) was chartered by the United States Congress in 1964 with a mission to formulate and widely disseminate information, guidance, and recommendations on radiation protection and measurements that represent the consensus of leading scientific thinking. It has had a role in radiation protection in the United States and the world since 1929 and has published well over 100 scientific reports. NCRP Report No. 116 (NCRP 1993) identifies a negligible individual risk level (NIRL) of 1×10^{-7}/yr. The NIRL is "*... the level of average annual excess risk of fatal health effects attributable to radiation below which efforts to reduce radiation exposure to the individual is unwarranted.*" This level of risk corresponds to a Negligible Individual Dose of 0.01 mSv/yr, or 1 mrem/yr. All of the doses estimated to occur from the blowdown line releases are below the NCRP's negligible levels.

NCRP Report No. 93 presents estimates of the average annual background radiation dose received by the United States population (NCRP 1987). The average annual dose to a member of the public from natural background radiation is 300 mrem/yr. When man-made sources of radiation are considered, of which medical x-rays, nuclear medicine, and consumer products are the major contributors, the background radiation dose increases to 360 mrem/yr.

The estimated doses from the blowdown line releases at the Braidwood Station are well below the applicable regulatory limits and present negligible risk—less than 0.1 percent of the risk from natural background radiation—to members of the public.

7. REFERENCES

10 CFR 20, Subpart D. Radiation Dose Limits for Individual Members of the Public.

10 CFR 50, Appendix I. *Numerical Guides for Design Objectives and Limiting Conditions for Operation To Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.*

40 CFR 190, Subpart B. Environmental Standards for the Uranium Fuel Cycle.

Commonwealth Edison. 1999. *Braidwood Station Annual Radiological Environmental Operating Report 1998.* Commonwealth Edison, Braidwood, Illinois.

Commonwealth Edison. 2001. *Braidwood Station Annual Radiological Environmental Operating Report 2000.* Commonwealth Edison, Braidwood, Illinois.

Conestoga-Rovers & Associates. 2006. *Tritium Investigation.* 16841-12-RPT. Conestoga-Rovers & Associates, Chicago, Illinois.

DOE (U.S. Department of Energy) 2002. *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota.* DOE-STD-1153-2002. U.S. Department of Energy, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1993. *External Exposure to Radionuclides in Air, Water, and Soil Federal Guidance Report No. 12.* EPA-402-R-93-081. U.S. Environmental Protection Agency, Washington, D.C.

EPA (U.S. Environmental Protection Agency). 1999. *Cancer Risk Coefficients for Environmental Exposure to Radionuclides Federal Guidance Report 13.* EPA 02-R-99-001. U.S. Environmental Protection Agency, Washington, D.C.

Exelon Nuclear. 2002. *Braidwood Station Annual Radiological Environmental Operating Report 2001.* Exelon Nuclear, Braidwood, Illinois.

Exelon Nuclear. 2003. *Braidwood Station Annual Radiological Environmental Operating Report 2002.* Exelon Nuclear, Braidwood, Illinois.

Exelon Nuclear. 2004. *Braidwood Station Annual Radiological Environmental Operating Report 2003.* Exelon Nuclear, Braidwood, Illinois.

Exelon Nuclear. 2005. *Braidwood Station Annual Radiological Environmental Operating Report 2004.* Exelon Nuclear, Braidwood, Illinois.

Halls, L. K. (date unavailable). "What Do Deer Eat and Why?" in *Wildlife Management Handbook.* [http://wildlife.tamu.edu/publications/A046.PDF]

Hosley, N. W. 1956. "Management of the White-Tailed Deer in its Environment" in *The Deer of North America*. Harrisburg, PA: Stackpole Co., and Washington, D.C.: Wildlife Manage. Inst. p. 187-259. [cited in Murphy 1970]

Murphy, D.A. 1970. "Deer Range Appraisal in the Midwest" in *White-Tailed Deer in the Midwest*, symposium presented at the 30th Midwest Fish and Wildlife Conference, Columbus, Ohio, December 9, 1968. USDA Forest Service Research Paper NC-39, North Central Forest Experiment Station, Forest Service, United States Department of Agriculture, St. Paul, MN.

NCRP (National Council on Radiation Protection & Measurements). 1987. *Ionizing Radiation Exposure of the Population of the United States*. NCRP Report No. 93. National Council on Radiation Protection & Measurements, Bethesda, Maryland.

NCRP (National Council on Radiation Protection & Measurements). 1996. *Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground.* NCRP Report No. 123 (two volumes). National Council on Radiation Protection & Measurements, Bethesda, Maryland.

NCRP (National Council on Radiation Protection & Measurements). 1993. *Limitation on Exposure to Ionizing Radiation*. NCRP Report No. 116. National Council on Radiation Protection & Measurements, Bethesda, Maryland.

NRC (Nuclear Regulatory Commission). 1977. *Calculation of Annual Dose to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I.* Regulatory Guide 1.109, Revision. Nuclear Regulatory Commission, Washington, D.C.

Strenge, D.L., R.A. Peloquin, and G. Whelan. 1985. *LADTAP II – Technical Reference and User Guide*. NUREG/CR-4013. Nuclear Regulatory Commission, Washington, D.C.